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Cleaning Products Fact Sheet

Default parameters for estimating consumer exposure - Updated version 2017

RIVM Report 2017

Colophon

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Abstract

Contents

Summary

The aim of the current report is to update the Cleaning Products Fact Sheet, an important document with default values for the assessment of consumer exposure to substances in cleaning agents. The default values are useful in the ConsExpo model, able to calculate consumer exposure to chemicals in consumer products via all different exposure routes. The values described in the previous version of the Cleaning Product Fact sheet are included in a database coupled to ConsExpo, which was developed by RIVM in the early nineties. Recently an online version (ConsExpo Web) has been launched and the standardized values in the current Cleaning Products Fact Sheet replace those of the previous one. ConsExpo is used by various (inter)national bodies and within different legal frameworks.

Product-specific default values are key information for consistent and harmonized estimation and assessment of the exposure to substances from consumer products when using ConsExpo. These are developed for different product categories and described in Fact Sheets providing consumer exposure scenarios for cosmetics, paints products, pest control products, disinfectant products, do-it-yourself products and children's toys. In addition, the General Fact Sheet (of which the most recent update has been published in 2014 by Te Biesebeek et al.) describes generic defaults for consumer exposure estimation such as body weight, surface areas of body parts, room sizes and ventilation rates.

The first version of the Cleaning Products Fact Sheet was written in 2006 (Prud'homme de Lodder et al., 2006a). In the current version, new available data are taken into account and default values are adjusted when necessary. Where possible, the default parameters are based on the Dutch situation. However, in absence of suitable data, information from outside the Netherlands has also been considered. The data underpinning the described defaults are explained and an evaluation of the quality of the data justifies their reliability. At the same time of publication of the updated factsheet, the ConsExpo database will be updated with the new defaults.

The current Cleaning Products Fact Sheet gives more detailed information compared to version of 2006. The scenarios explaining how consumer exposure is anticipated from intentional product use are more explicit. Standardized exposure estimation prescriptions are now given for every use activity from which consumer exposure is anticipated. As such, selected models and respective model parameter values are prescribed as defaults for the exposure estimation of substances in laundry detergents, dishwash detergents, -all-purpose cleaners, abrasives, bathroom cleaners, floor, carpet and furniture cleaners and more. The quality of the underpinning data is now ranked and for all defaults including a motivation. The current Fact Sheet also describes new data sources that have become available after 2006. Finally, all changes on exposure scenarios, selected ConsExpo models and default parameter values when compared to the former version published in

2006 are merged into one big data table, so that any alteration is traced easily.

Samenvatting

Het huidige rapport is een herziening van de Reinigingsmiddelen Factsheet, een belangrijk document met standaardwaarden (defaults) voor het maken van een consumentenblootstellingschatting aan stoffen in schoonmaakproducten. Deze defaults zijn toepasbaar in het ConsExpo model, dat consumentenblootstelling aan chemische stoffen in consumentenproducten via de verschillende blootstellingsroutes kan berekenen. De waarden beschreven in de Reinigingsmiddelen Factsheet zijn gekoppeld aan een database behorende bij ConsExpo, ontwikkeld in het begin van de jaren negentig en waarvan recent een online versie beschikbaar is gekomen (ConsExpo Web) waarbij de gestandaardiseerde waarden van de huidige Reinigingsmiddelen Factsheet die van de vorige versie vervangen. ConsExpo wordt gebruikt door diverse (inter)nationale organisaties en binnen verschillende wettelijke kaders.

Productspecifieke defaults zijn essentiële waarden voor een consistente en geharmoniseerde bepaling en beoordeling van de blootstelling aan stoffen in consumentenproducten bij het gebruik van ConsExpo. Deze defaults zijn ontwikkeld voor de verschillende productcategorieën en beschreven in de Factsheets met blootstellingscenario's voor productcategorieën zoals cosmetica, verfproducten, ongediertebestrijdingsmiddelen, speelgoed, desinfecterende middelen en doe-het- zelfproducten. Daarnaast staan defaults voor generieke parameters zoals lichaamsgewicht, lichaamsoppervlak, kamergrootte en ventilatievoud beschreven in de Factsheet Algemeen, waarvan de meeste recente versie in 2014 is verschenen (Te Biesebeek et al.).

De eerste versie van de Reinigingsmiddelen Factsheet dateert uit 2006 (Prud'homme de Lodder et al., 2006a). In de huidige versie zijn nieuwe beschikbare data beoordeeld en de defaults zijn aangepast, waar nodig. De data en de defaults zijn zoveel mogelijk gebaseerd op de Nederlandse situatie. Bij afwezigheid van geschikte Nederlandse data is er gebruik gemaakt van informatie uit andere landen. De onderliggende data die gebruikt zijn voor het verkrijgen van de defaults worden uitgelegd en de betrouwbaarheid van de defaults wordt verantwoord met informatie over de kwaliteit van deze data. Parallel aan het publiceren van de herziene factsheet, zullen ook de waarden in de ConsExpo database vervangen worden door de nieuwe waarden.

In vergelijking met de vorige versie uit 2006, geeft de huidige Reinigingsmiddelen Factsheet meer gedetailleerde informatie. De consumentenscenario's voor de beschrijving van het productgebruik zijn nu meer expliciet beschreven. Voor elk mogelijk gebruikersactiviteit die kan leiden tot blootstelling zijn gestandaardiseerde voorschriften (waarden?) gegeven. Dat houdt tevens in dat er meer specifieke modellen en defaults voor modelparameters staan voorgeschreven voor blootstellingsschatting voor stoffen in verschillende productgroepen; onder meer wasmiddelen, afwasmiddelen, allesreinigers, schuurmiddelen, badkamerreinigers, vloer-, tapijt, -en meubelreinigingsmiddelen. Alle defaults zijn nu voorzien van een kwaliteitscore van de onderliggende data inclusief een motivatie.

Daarnaast is er een samenvatting gegeven van nieuwe data die beschikbaar zijn gekomen na de publicatie van de vorige Reinigingsmiddelen Factsheet in 2006 en wordt de toepasbaarheid van deze bronnen besproken. Tot slot zijn alle veranderingen in blootstellingsscenarios, -modellen, default parameterwaarden en datakwaliteitsscores t.o.v. de versie uit 2006 samengevoegd in één grote tabel, zodat elke wijziging gemakkelijk te traceren is.

List of abbreviations

ACI	American Cleaning Institute
AISE	Association Internationale de la Savonnerie, de la Détergence et des Produits d' Entretien
BPR	Biocides Product Regulation
BZK	Ministry of the Interior and Kingdom Relations
bw	Body weight
CBS	Central Bureau of Statistics
CEFIC	Conseil Europeen des Federations de l'Industrie Chimique
ConsExpo	Consumer Exposure
c.v.	Coefficient of variation
DIW	Deutsches Institut für Wirtschaftsforschung
EC	European Commission
ECCC	Environment and Climate Change Canada
ECHA	European Chemical Agency
EPHECT	Emissions, exposure patterns and health effects of consumer products in the EU
ETH	The Federal Technical University (ETH) of Zürich
EU	European Union
FS	Fact Sheet
HC	Health Canada
HEAdhoc	Ad Hoc Working Group- Human Exposure (Biocides)
HEEG	Human Exposure Expert Group
HERA	Human and Environmental Risk Assessment
HSL	Health Safety Laboratory
KEMI	Swedish Chemical Agency
NEGh	Nordic Exposure Group for Human Health
NVZ	Nederlandse Vereniging van Zeepfabrikanten
NVWA	Dutch Food and Product Safety Authority (Nederlandse Voedsel en Warenautoriteit)
OECD	Organisation for Economic Co-operation and Development
PMRA	Pest Management Regulation Agency (Canada)
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RIVM	National Institute for Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu)
st. dev.	Standard Deviation
SVOC	Semi-Volatile Organic Compound
TNsG	Technical Notes of Guidance (Biocides)
UNECE	United Nations Economic Commission for Europe
US-EPA	United States – Environmental Protection Agency
VOC	Volatile Organic Compound
VSP	Centre for Safety of Substances and Products
VWS	Ministry of Health, Welfare and Sport
WHO	World Health Organisation
Q-factor	Quality Factor

1 Introduction

1.1 Background

The ConsExpo software was developed in the early nineties at the request of the Keuringsdienst van Waren (currently Netherlands Food and Consumer Product Safety Authority; NVWA) and the Ministry of Health, Welfare and Sports (VWS) in the Netherlands as a software model to calculate human exposure to chemicals from consumer products. ConsExpo is designed and used to estimate non-food consumer exposure to chemicals from consumer products via all exposure routes (inhalation, dermal and oral exposure). Over the years, the ConsExpo project was extended by the development of the fact sheets, which were incorporated into the ConsExpo software as a database.

The fact sheets are documents containing exposure scenario descriptions and default values for various product categories (Bremmer & Van Veen 2002; Bremmer et al., 2006a; 2006b; Bremmer & Van Engelen 2007; Ter Burg et al., 2007; Prud'homme de Lodder et al., 2006a; 2006b). In addition, there is a General Fact Sheet containing default values for parameters such as body weight, skin surface area, room volume, ventilation rate and activity patterns. This fact sheet was updated in 2014 (Te Biesebeek et al., 2014). The defaults described in the various fact sheets ensure an exposure assessment conducted in a harmonized and standardized way, providing reasonable worst-case estimates, and are fit for use in the ConsExpo Web software.

In October 2016, ConsExpo Web has been launched as an online web tool (www.consexpoweb.nl) for estimating exposure to substances in consumer products. ConsExpo Web is easily available via the internet and in principal similar to ConsExpo 4.1. The online tool is open for any future updates that improve the model. ConsExpo Web already allows the user to include multiple scenarios within a single assessment. In addition, a new model has been added to assess the exposure due to emissions from solid products (or articles) and a first tier, screening level model for the exposure to non-volatile substances in sprays was added to the 'exposure to spray' model. Finally, the terminology for the outputs has been updated and the calculated exposure metrics have been adjusted. An updated manual describing how to use the ConsExpo Web version, as well as a description of the available models present in the software, is available (Delmaar & Schuur, 2016).

The use of ConsExpo is recommended for the consumer exposure assessment under REACH (EC, 2006) and the model is described in the updated REACH guidance (ECHA, 2016). Furthermore, it is also one of the models recommended to be used for the assessment of consumer exposure to biocides (EU, 2012; ECHA, 2015a).

1.2 ConsExpo Web

RIVM developed ConsExpo Web an online software tool for consumer exposure assessment, to be able to assess the exposure to substances from consumer products. For this purpose, the software contains a set of coherent general, mathematical models. Consumer exposure can be estimated by choosing the most suitable model and filling in the required parameters of the product, such as the amount used or concentration of the substance within a product, and consequently the scenario.

ConsExpo is constructed using data on the use of products contained in fact sheets that are then combined with mathematical models. The program is based on relatively simple exposure models. The starting point for these models is the route of exposure, i.e. the inhalation, dermal, or oral route. The most appropriate exposure scenario and model is chosen for each route. Then, parameters needed for the exposure scenario and model, such as substance specific data, frequency and duration of use, are filled in the ConsExpo software for calculation of the exposure. Further details on the mathematics behind ConsExpo are described in the manual (Delmaar & Schuur, 2016).

ConsExpo can be used for a screening assessment (first tier, often used in regulatory frameworks) or for an advanced (higher tier) assessment. For different exposure situations, different models are provided for calculating external exposure. ConsExpo also integrates the exposure via the different routes, resulting in a systemic dose. Different dosing regimens/exposure situations can be calculated (acute, daily, chronic exposure). ConsExpo can also run calculations using distributed input parameters and perform sensitivity analyses.
The models per route of exposure included in ConsExpo have different levels of detail and complexity.
The ConsExpo tool is publicly available via www.consexpoweb.nl. Default data are available via the database, which is an integral part of the online tool. The manual and the various fact sheets can be consulted by following links to the website of the National Institute for Public Health and the Environment in the Netherlands (RIVM; www.rivm.nl/consexpo).

1.3 Fact Sheets

Fact sheets are documents that present key information for consistent and harmonized estimation and assessment of the exposure to substances from consumer products when using ConsExpo. In the fact sheets, information about exposure to chemical substances is bundled into certain product or exposure categories and default parameters are given. The main product categories with similar products have been defined. Examples of these categories are paint, cosmetics, toys and pest control products, which are chosen in such a way that products with similar exposure are covered by one scenario. The choice of main product categories and subcategories is based on the product classifications used under REACH, by the United States Environmental Product Agency (US-EPA) and the Swedish Chemical Agency (KEMI), as described by the Organisation for Economic Co-operation and Development (OECD, 2012).

The fact sheets are developed for characterizing and standardizing the exposure estimation in combination with the ConsExpo software, but are also useful for any exposure estimation without the use of the software.

Products are categorized and for each product category the composition and the use of the type of products are described. To estimate the exposure, default models with default parameter values are determined for every product category, which are available via a database in ConsExpo Web. Using these data, standardized exposure calculations for consumers resulting from, for instance, the use of cleaning products can be performed. The fact sheets described in Table 1 are currently available. In the near future, more fact sheets may be generated to cover other categories of consumer products.

Table 1: Main categories of consumer products, for which fact sheets are available.

Main categories of consumer products
Paint
Cosmetics
Children's toys
Pest control products
Disinfectants
Cleaning products
Do-it-yourself products

Main product categories are further divided into smaller product categories (subcategories). For example, the main product category Cosmetics includes the following product subcategories (amongst others): shampoo, make-up, lipstick, toothpaste and deodorant. The composition and the use of the type of products within the main category are examined for every product subcategory. To estimate the exposure of substances, default models with default parameter values are determined for every product subcategory.

The fact sheets provide general background information on exposure models. Furthermore, they describe various exposure scenarios for the specific products and set defaults for relevant exposure parameters. The default values are presented as deterministic values, but the statistical information is also provided if possible, which can be used in distributions in probabilistic (aggregate) exposure assessments.
In general, the following topics are dealt with in the fact sheets:

- Background information about the main category that is relevant for exposure
- Delimitation of the main category and description of the underlying product categories

Furthermore, the fact sheets contain a general description of the product category and information on the way the products are used with regard to:

- Composition of the products
- Remarks about the product
- Potentially problematic substances
- Default scenarios and models
- Default parameter values for the scenarios and models
- Considerations that have led to the defaults

"The General Fact Sheet" (Te Biesebeek et al., 2014) gives general information about the fact sheets and deals with overarching topics that

are relevant for several other main product categories, providing further details about:
- The boundary conditions under which the defaults are estimated
- The way in which the reliability of the data is shown
- Parameters such as the ventilation rate and room size
- Anthropometric parameters such as body weight and the surface of the human body, or parts thereof and inhalation rates and activity patterns.

The default values from the General Fact Sheet are used in the other fact sheets as long as there is no profound data to define individualized values for the separate scenarios.

2 Default setting and quality of the data

The underlying data used to estimate consumer exposure for default scenarios described in the fact sheets is collected from scientific literature, product information, legislation documents, survey data on consumer habits, and experimental data on substance release from consumer products. Defaults are set according to exposure scenarios. The quality of the collected data is assessed in order to describe whether and where further improvements of consumer exposure estimation with ConsExpo can be achieved by collecting more and better data. ConsExpo users are also informed about default fact sheet values and the uncertainty associated with the data, and therefore with the exposure estimate.

2.1.1 *Default setting*

Default parameter values are selected to represent a reasonable worst-case scenario that considers consumers who frequently use a certain product under relatively less favourable conditions. For example, when using a cleaning product, parameter values are selected to represent a scenario in which use is relatively frequent, the product is applied in a relatively large amount, in a small room with low ventilation rate, in which the exposed person stays for a relatively long duration.

Although ConsExpo was originally developed for the Dutch consumer market, the parameter values are now aimed at consumers in general. When information is available and when relevant, differences will be described for the European and North American population.

The parameter values are chosen to generate a relatively high exposure estimate, i.e. in order of the magnitude of a 99th percentile of the population distribution. The reasonable worst case aims to represent high-end users. To achieve this goal, the 75th or the 25th percentile is determined for each parameter. The 75th percentile is normally used for proportional parameters. However, a decrease in for example room volume or ventilation leads to an increase of the exposure estimate. In the case of such reverse proportional parameters, the 25th percentile is used. For a significant number of parameters, there are actually too few data to calculate the 75th or 25th percentile. In such cases, an estimate, corresponding to these percentiles is made.
Multiplication of two 75th percentile parameters will result in a 93.75th percentile, whereas multiplication of three 75th percentile parameters will result in a 98.5th percentile. The dermal, inhalation and oral exposure models included in ConsExpo all require at least three input parameters, but more for the most part. Hence, a 75th percentile for those parameters would yield an approximate 99th percentile for the calculated exposure estimate. The result is a 'reasonable worst-case' estimate for consumers who use relatively large amounts of a product under less favourable circumstances (Figure 1).

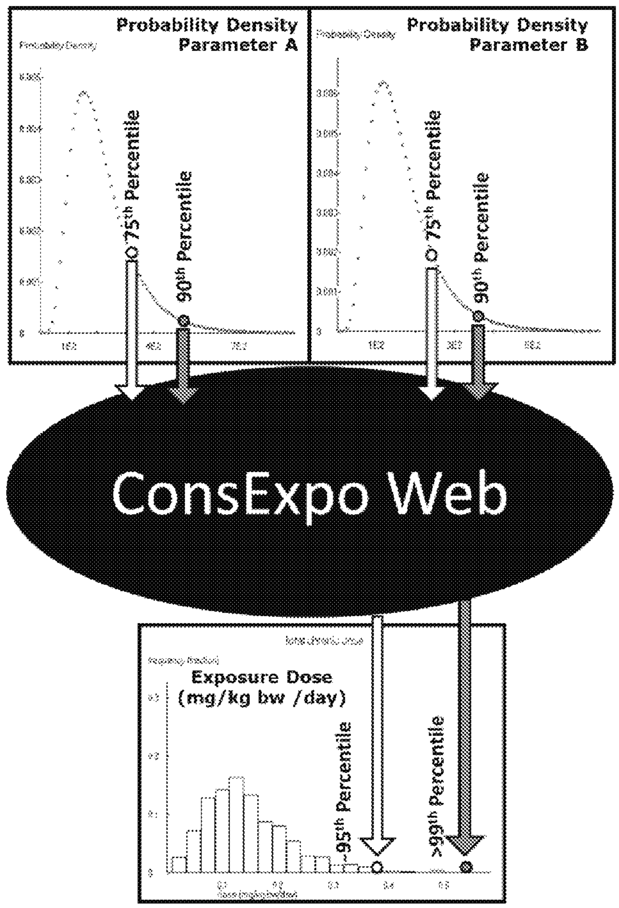

Figure 1: Illustration of the estimation of a 'reasonable worst-case' from variable data. Choosing a 75th percentile of the data for two uncorrelated parameters as input for a multiplicative model results in approximalety a 95th percentile of the exposure distribution. Choosing higher percentiles from each of the input data, such as a 90th percentile, quickly leads to an unrealistic overestimation. The effect of this 'cumulation' of worst case assumptions increases with the increasing number of input parameters.

A probabilistic exposure assessment requires distributions of parameter values instead of deterministic point values. Such distributions were not reported in the previous version of the fact sheet from 2006 (Prud'homme de Lodder et al., 2006a), but are, where available, provided in this fact sheet. If a distribution is not available, a reference may be provided.

2.1.2 *Quality of the default*

Availability of data is different for each exposure parameter. For a number of parameters there is insufficient data to derive a reliable default. To indicate the reliability of a default value, a quality factor (Q) is used. The quality factor ranges from 1 (low quality) to 4 (high quality), see Table 2.

Low Q-factors (Q=1 or 2) indicate that the default value is based on data that is not directly compatible with the exposure scenario, data that come from a limited data source and/or based on expert judgement only. If such a default is used in an exposure analysis, it should be used with caution. If more representative data is supplied by applicants, producers or is available from other sources, this data should be weighted higher than the default value with the low Q factor.

High Q-factors (Q= 3 or 4), on the other hand, indicate that the defaults are based on sufficient data. High quality defaults are generally associated with less uncertainty compared to those with low Q-values. It is possible that some parameters need to be adapted according to the exposure scenario. For example, if exposure estimation is carried out for a room of a particular size, the actual value should be weighted higher than the default value with a high Q factor.

Table 2: Value of quality factor Q

Q-Factor	Description
4	Good quality relevant data, parameter value reliable
3	Number and quality of the data satisfactory, parameter value usable as default value
2	Parameter value based on single data source supplemented with expert judgement
1	Educated guess, no relevant data available, parameter value only based on expert judgement

3 Cleaning Products Fact Sheet

The first version of the Cleaning Products Fact Sheet was written in 2006 (Prud'homme de Lodder et al., 2006a). Since this version, new data have become available which have been evaluated and included, if appropriate. A summary table of updated defaults is presented in Annex I. The default values are initially selected to represent a European scenario. However, information from other countries, such as the United States of America and Canada is used as well. As ConsExpo is used for several different legal frameworks, special attention is given to default values as set in guidance document for implementation of e.g. the REACH (ECHA, 2016) or Biocides Regulation (EU, 2012).

3.1 Cleaning products

The Cleaning Products Fact Sheet covers the major sources of exposure from the use of cleaning products by consumers. Products that are available on the consumer market to be used for cleaning are included in this fact sheet, including products to clean in-house surfaces, but also products such as laundry detergents, dishwashing products, and toilet cleaners (Table 3). Products with an application that is comparable to cleaning products, like shoe polishes, are included as well. Therefore, no distinction is made between exposure from use of polishing and cleaning products within the exposure scenarios.

Table 3: Product categories of cleaning products described in this fact sheet

Chapter	Product type	Product categories
6	Laundry products	Powder
		Liquid, bleach
		Fabric conditioners
		Laundry pre-treatment products
		▪ Liquid
		▪ Spray
		▪ Paste
7	Dishwashing products	Hand dishwashing, liquids
		Machine dishwashing products
		▪ Powder
		▪ Liquid
		▪ Tablet
		▪ Salt
8	All-purpose cleaners	Liquid, bleach
		Spray
		Wet tissues (wipes)
9	Abrasives	Powder
		Liquid
10	Sanitary products	Bathroom cleaners
		▪ Liquid
		▪ Spray
		Toilet cleaners
		Toilet rim cleaners

11	Floor and furniture products	Floor products ▪ Liquid ▪ Wet tissues (mopping) ▪ Polishes ▪ Strippers ▪ Sealers Carpet products ▪ Powder ▪ Liquid ▪ Spray extraction machine ▪ Spray foams Furniture and leather products ▪ Furniture polish ▪ Leather furniture polish
12	Miscellaneous	Glass cleaners Oven cleaners Metal cleaners Drain openers Shoe polish products ▪ Spray ▪ Cream Pressure washers Electronic cleaners

The fact sheet principally aims to predict exposure emerging from the use of the whole product and is independent of the substance of interest. The default values that are presented serve to characterize consumer use of cleaning products. Information about specific substances within the cleaning product, such as concentrations and physical-chemical properties, must be factored into the exposure assessment separately by the evaluator. Exposure routes that are not realistic, for example inhalation exposure of laundry tablets, are not considered in this fact sheet.

3.2 Ingredients in cleaning products

The major ingredients of cleaning products can be classified according to their function as surfactants, builders, solvers or anti-microbial compounds (American Cleaning Institute, 2015; NVZ, 2014; www.isditproductveilig.nl, 2015). Examples of other important ingredients are bleaching agents, enzymes and abrasives.

Surfactants
The most important group of detergent ingredients are surfactants, also called surface-active agents. These organic chemicals improve the wetting ability of water, remove dirt with the aid of washing action and they emulsify, solubilize or suspend dirt in the wash solution. Surfactants can be classified by their ionic properties in water as anionic, non-ionic, amphoteric or cationic surfactants (American Cleaning Institute, 2015).

- Anionic surfactants are used in laundry, hand dishwashing detergents and household cleaners. They have excellent cleaning properties and produce great volumes of suds. Linear alkyl benzene

sulphonate, alcohol ethoxysulphates, alkyl sulphates and soap (fatty acids salts) are the most common anionic surfactants.
- Non-ionic surfactants produce low volumes of suds and are typically used in laundry, automatic dishwasher detergents and rinse aids. They are resistant to water hardness and clean well on most types of dirt. The most widely used non-ionic surfactants are alcohol ethoxylates.
- Amphoteric surfactants are applied in household cleaning products for their mildness, suds production and stability. Imidazolines and betaines are the major amphoterics.
- Cationic surfactants are used in fabric softeners (laundry detergents) or as disinfecting/sanitizing ingredients in household cleaners. Quaternary ammonium compounds are the most used cationics in cleaning agents.

In addition, mixtures of the above described surfactants are possible, since many cleaning products include two or more of them.

Builders
Builders improve the cleaning effectiveness of the surfactants by reducing the water hardness through sequestration (i.e. holding hardness minerals in solution), precipitation (forming an insoluble substance) or by ion exchange. Builders also supply and maintain alkalinity which assists in the cleaning of acid types of dirt, prevents redeposition of removed dirt during washing, and emulsifies oily and greasy types of dirt. Complex phosphates and sodium citrate are common sequestering builders, whereas sodium carbonate and sodium silicate are precipitating builders. Sodium aluminosilicate (zeolite) is an example of an ion exchange builder (American Cleaning Institute, 2015).

Solvents
Solvents are added to the cleaning product to increase the cleaning effect of surfactants by dissolving oil and grease. They clean without leaving residues. Solvents used in cleaning products are water-soluble. Ethanol, isopropanol and propylene glycol are solvents widely used in laundry detergents, household cleaning products and dishwashing products (American Cleaning Institute, 2015).

Anti-microbial compounds
Anti-microbial compounds exterminate or inhibit the growth of microorganisms that cause diseases and/or odour. The most used anti-microbial compounds are pine oil, quaternary ammonium compounds, sodium hypochlorite, triclocarban and triclosan (American Cleaning Institute, 2015).

Miscellaneous
Other ingredients added to cleaning products include bleaching agents, enzymes, abrasives, acids, fragrances, dyes and preservatives. Short descriptions of these groups of ingredients are given below.

- Bleaching agents help whiten, brighten and remove stains. Oxygen bleach is used in laundry or machine dish washing detergents, toilet surface cleaning and sanitizing products. Examples are sodium perborate tetrahydrate or sodium perborate. Chlorine bleaches such as sodium hypochlorite are also disinfectants, which are used for hard surface cleaning and sanitizing.

- Enzymes aid in breaking down complex types of dirt into simpler forms prone for removal by detergents. They are only active against one specific kind of dirt. Therefore, different types of enzymes are used in household products such as amylase for starch soils, lipase for fatty and oily types of dirt and protease for protein soils. Cellulase reduces pilling and greying of fabrics containing cotton and helps remove particulate soils.
- Abrasives consist of small mineral particles for smoothing, scrubbing and/or polishing action. The most used minerals are calcite, feldspar, quartz and sand.
- Acids neutralize or adjust the alkalinity of other ingredients of household cleaning agents. Some special cleaners need extra acidity to remove mineral build-up. Acetic acid, citric acid, hydrochloric acid, phosphoric acid and sulphuric acid are the most used acids in cleaning products.
- Alkalis neutralize or adjust the acidity of other ingredients and make surfactants and builders more efficient. High alkalinity is useful in removing acidic, fatty and oily types of dirt. Ammonium, ethanolamines, sodium carbonate, sodium hydroxide and sodium silicate are commonly used alkalis.
- Fragrances (blends) cover odour of stains and mask the base odour of the other ingredients and package. They also provide a special identity to the product and leave a pleasant scent to clothes or rooms after washing and cleaning.
- Colorants, such as pigments and dyes, provide a special identity to a product and provide a bluing action. Opacifiers reduce transparency or provide a special effect to the product. The most used colorants are polymers and titanium dioxide.
- Preservatives protect against natural effects of product aging, decay, discoloration, oxidation and bacterial raid. Examples of preservatives are butylated hydroxytoluene, ethylene diamine, tetraacetic acid or glutaraldehyde.
- Processing aids, such as clays, solvents and polymers, provide important physical characteristics like flow, viscosity, solubility, stability and uniform density to cleaning agents.
- Suds control agents ensure the optimum foaming level needed. Suds stabilizers and suds suppressors are added to maintain high sudsing when needed or to reduce suds production in case of interference with cleaning action. Examples of suds stabilizers are alkanolamides and alkylamine oxide. Soap, alkyl phosphates and silicones are examples of suds suppressors.
- Hydrotropes such as cumene sulfonates, ethyl alcohol, toluene sulphonates and xylene sulphonates, prevent liquid products from separating into layers, so that product homogeneity is ensured (ACI, 2015).

4 Generic scenarios and models for cleaning products

The use of cleaning products results into either dermal, inhalation, or oral exposure or to a combination of these exposure routes. The exposure is determined by the type of product and the way the product is used. Because a product formulation and use is often similar across different cleaning products, exposure can be quite comparable as well. Hence, the same models and scenarios can therefore be applied to consumer exposure assessment for different products. Within the current Cleaning Products Fact Sheet -update 2017- the generic scenarios describe the use of the product, exposure conditions, as well as appropriate ConsExpo models to calculate exposure during the different stages of product use or the aftermath of the product use itself. The different stages of product use that are considered generic for cleaning products are:

- Mixing and loading (see 4.1)
    - Powder[1]
    - Liquid[2]
    - Product dilution with water
- Application (see 4.2)
    - Spray applications
    - Ready-to-use products
    - Surface treatment
- Secondary exposure (post application, see 4.3)
    - Rubbing off
    - Hand-to-mouth
    - Migration of residues from textile
    - Ingestion residues from dinner ware

The current chapter only addresses generic default parameters and scenarios that are applicable to several products within this fact sheet, such as the mixing and loading of powder materials. Chapters 6 to 12 provide the default scenarios, models, and parameter values to estimate exposure for relevant exposure routes for the product categories mentioned in Table 3 (including those set in this Chapter). The models themselves are described in the help file and the user manual of ConsExpo Web (Delmaar & Schuur, 2016).

4.1 Mixing and loading

Mixing and loading describes the preparation steps of mixing and loading required prior to application of the product, including refill of product containers in between applications. Mixing and loading of cleaning products mainly involves loading of powders and liquids. The use of powder products may lead to inhalation of aerosols or dermal exposure. The use of liquids may lead to inhalation exposure due to evaporation of volatile chemical substances and dermal exposure. Dilution with water is

[1] Tablets and salts also belong to the group solids, but powders are considered worst-case. Tablets and salts are addressed when necessary in the specific product type chapters
[2] Paste is considered to be a liquid, but powders are considered worst-case. Tablets and salts are addressed when necessary in the specific product type chapters

considered to be a mixing step, where during dilution dermal exposure may occur from dipping the hands into the water. Inhalation exposure may occur to substances evaporating from the water. In the next paragraphs, the generic scenarios are described for the expected routes of exposures. Furthermore, it is explained for what type of products no exposure from mixing and loading is expected.

4.1.1 *Generic exposure scenario for loading powders*

Powders are handled either by pouring straight from the package or by using a measuring cup or spoon. Both methods lead to the generation of aerosol particles that may be inhaled or deposit on the skin. Moreover, direct skin contact with the powder can occur during handling of the product.

Inhalation
The general scenario comprises the inhalation of product dust due to the loading of 200 g powder into a bucket or machine (Van de Plassche et al., 1999; AISE, 2002). No distinction is made between loading directly or through the use of a measuring cup or spoon, as it is not expected to result in a different exposure.

Within ConsExpo Web, the ***inhalation – exposure to spray - instantaneous release*** (Delmaar & Schuur, 2016) is suggested to estimate exposure by inhalation of product particles during the loading of powders in contrast to the previous Cleaning Product Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribed the exposure to vapour-instantaneous release mode. The underlying algorithms for both models however are the same (Delmaar & Schuur, 2016), but physicochemical properties of powders have more in common with spray droplets than vapours, e.g. particle shapes and the occurrence as non-volatile substances. Although a powder is obviously not a spray, the instantaneous release of spray model is therefore best suited to approximate the exposure during loading of powder. The release is expected to be very short-lived and therefore the instantaneous release is preferred over the spray model. Default values are given for the following model parameters for simulation of the generic scenario of exposure to powders.

- Exposure duration

The exposure duration is considered to be equal to the release duration. Prud'homme de Lodder and co-authors describe a default of 0.25 min (15 s) for loading powders to a washing machine (Prud'homme de Lodder et al., 2006a) based on the 75th percentile calculated from the data of Weegels (n=10, mean =11 st. dev. =3 s) (Weegels, 1997). The Q-factor is set to 3, because it is underpinned with quantitatively rich but generic data.

- Released mass

Little information is available about the fraction of powder that is released to indoor air during loading. Many literature sources erroneously refer to a released mass of 0.27 µg powder per cup (200 g) of product used for machine washing (HERA, 2002; 2003; 2005) including the previous Cleaning Product Fact Sheet (Prud'homme de

Lodder et al., 2006a). The original experiments and home observation studies were performed by Hendricks (1970). The author found "that there is on average 0.27 µg detergent dust exposure per cup of product used". Here the detergent dust exposure refers to the amount of laundry detergent inhaled while "pouring the product from the carton into a measuring aid and then to the washing machine" (Hendricks, 1970; Burg et al., 1970; Van de Plassche et al., 1999). The misinterpretation by referring to 0.27 µg per cup as 'released mass' instead of 'inhaled mass' yields an underestimation of exposure. However, it is possible to recalculate the supposed released mass in the experiments of Hendricks (1970) based on the laboratory conditions described (sampling time of 2 min, distance to dust source within personal breathing zone, inhalation rate of 16.3 l/ min), by assuming that Cons Expo's ***inhalation – exposure to spray - instantaneous release*** (Delmaar & Schuur, 2016) is suitable for such a calculation and that the experiments are too short-termed for ventilation rate to be effective. The supposed released amount per cup (8.3 µg) is calculated as follows:

$$Released\ Mass = \frac{Inhaled\ Mass}{(Inhalation\ Rate \times Sampling\ Time)/(Personal\ Breathing\ Zone\ Volume)} = \frac{0.27\mu g}{(0.00163\ m^3/\min \times 2\min)/1m^3} = 8.3\mu g$$

In addition, another estimation of inhalation exposure to dust is available, and based on data from Environment and Climate Change Canada and Health Canada (ECCC & HC, 2016). They report an estimated inhalation exposure to boron in laundry detergent powder based on data of the Pesticides Handlers Exposure Database (PMRA, 2002). In this exposure estimation, an inhaled mass of 56.2 µg is considered, but the conditions under which the 56.2 µg is derived are not available (Pellerin, 2001) making it impossible to derive a supposed released mass.
The generic default for released mass for mixing and loading of powders is therefore set to 8.3 µg. The Q-factor is set to 1, because the data was not specifically collected for the released mass of detergent powder and it is unclear to what extents the physicochemical properties of laundry detergent powder in 1970 still represent the properties of detergent powders nowadays. Moreover, the following assumptions are made in the calculation: an instant release model is suitable for the calculation above, ventilation is negligible and the short distance to the analytical device to the loaded powder is representing a personal breathing zone of 1 m^3. Therefore, it is recommended to, where possible, directly calculate inhalation exposure to detergent powder as a function of the inhaled mass of 0.27 µg per cup.

- Room volume

Since the consumer is holding the container during loading of powders, the powder is released into the personal breathing zone. Since only this small area around the user is relevant for inhalation exposure, room volume is interpreted as the personal breathing zone. Hence, the default for room volume is set equal to a personal breathing zone of 1 m^3. The Q-factor is considered to be 1, because the interpretation of the personal breathing zone is based on expert judgement.

Dermal
Within ConsExpo Web, the ***dermal – direct product contact – constant rate*** is suggested to estimate dermal exposure to powder during loading.

- Contact rate

In the Guidance on the EU Biocidal Products Regulation (BPR), a dermal exposure study for the use of sprinkling/dusting powders to control dust mites has been described (ECHA, 2015a). The subjects in the study applied crack and crevice powders in a kitchen treating skirting boards, shelves and laminate surfaces. The dermal exposure on hands and forearms ranges from 0.4 to 4.18 mg/min with a 75th percentile of 2.83 mg/min. The contact rate for dermal exposure for legs, feet and face ranges from 0.22 to 6.56 mg/min with a 75th percentile of 2.15 mg/min. The default for contact rate of ca. 5.0 mg/min (2.83 + 2.15), probably overestimates the exposure to loading of cleaning powders. This is in contrast to the reference source of BPR that describes an exposure to estimate the dermal exposure estimate of a cleaning task. Therefore, the default is set to 2.83 mg/min (the value only for hands and forearms). The Q-factor is considered to be 2, because the underlying data is rich but collected for another exposure scenario.

- Release duration

The release duration is considered to be equal to the exposure duration for inhalation: 0.25 min with a Q-factor of 3, because it is underpinned with quantitative but specific (non-generic) data.

4.1.2 *Generic exposure scenario for loading liquids*

Liquids are either poured straight from the bottle or loaded first into a measuring cup and then into a bowl or bucket. Volatiles evaporate from the open bottle (or measuring cup) leading to inhalation exposure, whereas dermal exposure could occur during pouring via spills and droplets.

Inhalation
During mixing and loading, substances evaporate through the opening of a bottle that contains the product of interest. In this scenario it is assumed that the product is in a one-litre bottle that has a 'not-too-small' circular opening of 5 cm diameter and a surface area of 20 cm^2. To calculate the inhalation exposure during mixing and loading within ConsExpo Web, the ***inhalation – exposure to vapour - evaporation*** is used.

- Exposure duration

The first Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 0.75 min, based on the 75th percentile for filling a dishwasher with a polish liquid. The consumer pours the product into a small box located at the front of the machine (Weegels, 1997). It is assumed that the duration of this activity is generic for loading liquids. The duration default value remains 0.75 min with a Q-factor of 3.

- Product amount

The bottle containing the product will not be full during its entire service life. Rather, the bottle will be full at first use and empty at the end of its service life. On average, the bottle will therefore be half-full. Hence, the default for product amount is set at half of the content of the one-litre bottle (density 1 g/cm^3), i.e. 500 g. The Q-factor is set to 2, because the description is generic but not underpinned by quantitative data.

- Room volume

During loading of liquids the consumer is holding the bottle or measuring cup. The volatile substance from the liquid is then released into the personal breathing zone. Since only this small area around the user is relevant for the inhalation exposure, room volume is interpreted as the personal breathing zone. Hence, the default for room volume is set equal to a personal breathing zone of 1 m^3. The Q-factor for this default value is set to 1, because the interpretation of the personal breathing zone is based on expert judgement.

- Release area

The opening of the bottle is considered to be the release area for substances evaporating from a bottle, which is by default set at 20 cm^2, which is a conservative estimation. The Q-factor is set to 2, because the description is generic but not underpinned by quantitative data.

- Emission duration

The emission duration is interpreted here as the duration of the activity of loading liquids. It is assumed that the duration of this activity is generic for loading liquids. The duration default value remains 0.75 min with a Q-factor of 3.

Dermal

The generic exposure scenario for loading liquids considers two ways to do so: pouring the liquid product into a cup first or pouring the liquid directly from the bottle into a bucket, bowl, or machine. Direct pouring can lead to dermal exposure through spatters, whereas pouring the product into a cap first can lead to dermal exposure through spills. To estimate the exposure within ConsExpo Web, the ***dermal – direct product contact - instant application*** is used for both direct pouring and the loading with cups. However, the default values for product amount and exposed area differ for the two ways of liquid loading.

- Exposed area - direct pouring

It is assumed that direct pouring of liquids leads to dermal exposure at one side of the hand directing the bottle to the machine, bowl or bucket. The default for exposed area is set to be equal to one side of the hand: 225 cm^2, which is in accordance with the General Fact Sheet (Te Biesebeek et al., 2014). As the assumption for the exposed area is difficult to estimate (although the default for hand surface area is derived from a data rich source), the Q-factor is set to 2.

- Product amount - direct pouring

The Biocides Human Health Exposure Methodology Document (ECHA, 2015a) describes dermal exposure of consumers to biocides when dispersing a concentrate from a one-litre can and diluting it with water in a small vessel. The 75th percentile for dermal exposure during this mixing and loading event is 0.01 ml, irrespective of the amount poured (ECHA, 2015a). Assuming a liquid density of 1 g/cm^3, the default for product amount for direct pouring is set a 0.01 g. Because the data are quantitative but specific (non-generic), the Q-factor is set to 3.

- Exposed area - pouring with caps

It is assumed that pouring of liquids with caps leads to dermal exposure at the fingertips and phalanges holding the cap. The General Fact Sheet describes a default surface area of a hand of 450 cm^2. The surface area of fingers is then 225 cm^2 (half the surface area of the hand). The surface area of one finger and one phalanx is assumed to be 45 cm^2 and 15 cm^2, respectively. The consumer holds the cup with the thumb and the top two phalanges of the forefinger and middle finger, which has a surface area of 105 cm^2 (thumb (45cm^2) + two phalanges of forefinger: 2 x 15 cm^2 = 30cm^2 + two phalanges of middle finger: 2 x 15 cm^2 = 30 cm^2 = 45+30+30 = 105). Half of this surface area is pressed to the cup (52.5 cm^2), so that the other half is potentially exposed during a spill (52.5 cm^2). The default for exposed area is thus set to 52.5 cm^2, which is also in good agreement with other exposure scenarios from handling products with the fingers. In the Guidance on the EU Biocidal Products Regulation (ECHA, 2015b), the exposed area of the fingers of one hand handling a wax block is estimated by expert judgement as 30 cm^2. In the Biocides Human Health Exposure Methodology report of 2017, this value has been adjusted to 60 cm^2 (ECHA, 2017). The DIY Products Fact Sheet (Ter Burg et al., 2007) prescribes a default of 215 cm^2 for the entire exposed area of 10 fingers, so that one finger would have an exposed surface area of 21.5 cm^2, one phalanx 7.1 cm^2 and one thumb plus 4 phalanges thus 50cm^2.
The Q-factor of the default of 52.5 cm^2 is set to 2, as the estimation for the exposed area is based on several assumptions, even if the default for hand surface area is derived from a data rich source.

- Product amount - pouring with caps

The default product amount for dermal exposure while pouring liquids with caps is calculated as the exposed area of (52.5 cm^2) multiplied with the layer thickness (0.01 cm) and density (1 g/cm^3): 0.525 g.
The layer thickness applied here is taken from the Guidance on the EU Biocidal Products Regulation (BPR) (ECHA, 2015a) in which a general layer thickness for liquid runoffs is set at 0.01 cm. This value is supported by recent scientific literature. The US-EPA (2011) conducted a study resulting in a number of 74 values on thickness layer (mean each from 4 volunteers) showing that only one value was slightly higher than 0.01 cm (0.01187 cm). Weerdesteijn et al. (1999) performed an experiment involving the immersion of hands into a bucket with water and calculated based on the surface area of hand male and female a 75th percentile layer thickness of 0.009 and 0.007 cm, respectively. Based on ECHA (2015), US-EPA (2011), and Weerdesteijn et al. (1999), it is assumed that a layer thickness is 0.01 cm is appropriate for calculating the product amount in case of dermal exposure from loading liquids with cups. Therefore, the default product amount is set at 0.525 g with a Q-factor of 3, because it is underpinned with quantitative but specific (non-generic) data.

4.1.3 *Generic exposure scenario ready-to-use products*

Ready-to-use products are directly available for application once their packaging is removed. Removing the packaging can be regarded as a form of mixing and loading, but exposure during this activity will mostly be negligible. Examples of such activities are removing a plastic foil in the bottlenecks of trigger sprays or hand pumps. Other products do not even have a packaging, so that there is no mixing and loading at all. Examples of such products are aerosol spray cans, impregnated tissues or cleaning tablets packed in soluble foils such as detergent pods. If a product is identified as a ready-to-use product, then it is assumed that exposure from mixing and loading is negligible compared to exposure during application and secondary exposure.

4.2 Application

Application of cleaning products involves tasks which can be considered generic for consumer exposure estimation. In this fact sheet the generic cleaning product applications are the use of spray applications (e.g. all-purpose, bathroom and kitchen cleaners) and surface cleaning (e.g. cleaning and polishing of floors and furniture).

4.2.1 *Spray applications*

Inhalation
A major pathway of exposure to spray applications is the inhalation of respirable aerosol particles generated during the use of aerosol spray cans or trigger sprays. Inhalation exposure to these aerosol particles is driven by a variety of exposure parameters such as the ventilation rate of the room, the duration of presence of the exposed person in the room during or after spraying, and the way the product is used.
The general exposure scenario for inhalation of substances from spray applications provides interpretation and/or defaults for parameters referring to spray duration, density of non-volatile substances and mass generation rate (i.e. the released mass per unit of time during spraying) for both aerosol spray cans and triggers sprays.
The ***exposure to spray – instantaneous release*** is used to estimate the exposure to volatile substances from cleaning products available on the market as sprays (see 4.2.2.1).The ***Exposure to spray - spraying*** is used to estimate inhalation exposure to non-volatile substances when using cleaning products as sprays. The parameters of this spray module within ConsExpo Web are experimentally evaluated in the report of Delmaar & Bremmer (2009). Exposure duration, room volume, ventilation rate, and initial particle distribution are parameters that are not generic. Instead, defaults are specifically derived per scenario of consumer exposure. The other parameters in ***Exposure to spray - spraying*** are discussed below describing either the derivation of a generic default value or at least a generic approach to do so. These generic defaults and approaches are consistent with the manual of ConsExpo Web (Delmaar & Schuur, 2016), the set of experiments evaluating the critical parameters of the model (Delmaar & Bremmer, 2009), and the General Fact Sheet (Te Biesebeek et al., 2014). All

consumer exposure scenarios described in the current factsheet for substances in cleaning sprays do not consider the 'spraying toward person' option, because the intended use is to spray towards surfaces that are to be cleaned.

- Spray duration

Spray duration is defined here as the net spraying time between start and finish of spraying, not counting time between sprays (Delmaar & Schuur, 2016). The definition of spray duration is in contrast to that of the Cleaning Product Fact Sheet published in 2006 (Prud'homme de Lodder et al., 2006a) where spray duration is defined as the entire duration of the cleaning task (Annex I, Table A2). The previous Cleaning Product Fact Sheet considers spraying that is performed intermittently accounting for multiple spraying activities with a non-spraying time in between. ConsExpo Web (Delmaar & Schuur, 2016) however describes the spray duration for the time that is spent for actual spraying during the event thus excluding the non-spraying time. A clear definition of "spray duration" is important, because the amount of spray available for inhalation is simulated in ConsExpo Web from the mass generation rate of the spray, the spray duration and ventilation (Delmaar & Schuur, 2016). Default values for spray durations however are derived per specific scenario for consumer exposure.

- Room height

The default of room height is based on a standard room height of 2.5 m as explained in the General Fact Sheet (Te Biesebeek et al., 2014). The Q-factor is set to 4, because it depends on quantitatively rich data sources, also described in the General Fact Sheet.

- Inhalation rate

The consumer is expected to be at rest during the cleaning task with spray products, so that the inhalation rate is by default set to 0.55 m^3/h for adults (Te Biesebeek et al., 2014).

- Mass generation rate- aerosol spray cans

The definition of mass generation rate of sprays is in contrast to that of the Cleaning Product Fact Sheet published in 2006 (Prud'homme de Lodder et al., 2006a) where mass generation rate is defined as the *average mass released per unit of time over the entire duration of the cleaning task*. In the current Cleaning Product Fact Sheet, the mass generation rate of a spray product is defined as the *mass released per unit time of spraying*. In the study by Delmaar & Bremmer (2009) such mass generation rates were determined for aerosol spray cans by spraying for 10 seconds and determining the weight loss in the spray can afterwards. To get more insight into the variation of the mass generation rate during the lifetime of the product, the weight loss was measured when the spray container was still full and also when the container was nearly empty (Delmaar & Bremmer, 2009). In these experiments performed on 17 aerosol spray cans the mass generation rate ranged between 0.29 and 2.2 g/s. This is consistent with the data from a comparable series of experiments by Tuinman (2004 & 2007) that show a 75^{th} percentile of 1.2 g/s. The default mass generation rate for aerosol spray cans is therefore set at 1.2 g/s. The Q-factor is set to 3, because the underpinning data is quantitatively rich but in a specific exposure scenario a specific mass generation rate is still preferred over a generic one.

- Mass generation rate- trigger sprays

In addition to the aerosol spray cans, Delmaar & Bremmer (2009) experimentally determined mass generation rates for trigger sprays by squeezing 10 times (which approximately takes 6 seconds) and determining the weight loss in the spray can afterwards. The obtained mass generation rates of 6 different trigger sprays ranged between 1.0 and 1.5 g/s. This is consistent with the data from the comparable series of experiments by Tuinman (2004; 2007) that show a 75th percentile of 1.6 g/s for trigger sprays. The default mass generation rate for aerosol spray cans is therefore set at 1.6 g/s. The Q-factor is set to 3, because the underpinning data is quantitatively rich but in a specific exposure scenario a specific mass generation rate is still preferred over a generic one.

- Airborne fraction

The airborne fraction is defined as the fraction of the non-volatile material that becomes airborne after spraying as droplets. The airborne fraction will depend on the way in which the product is being used as well as on the aerosol diameter distribution that has been specified. Cleaning sprays are used to clean surface and are therefore sprayed towards surfaces. In the series of experiments of Delmaar & Bremmer (2009) it was found that airborne fractions are relatively low for sprays that are used to treat a surface ranging from 0.006 to 0.18 (n=4). The default airborne fraction for cleaning sprays is set to 0.2, which is a conservative value, consistent with the previous Cleaning Product Fact Sheet (Prud'homme de Lodder et al., 2006a). The Q-factor is set to 2, because the surface sprays that are evaluated in the experiments of Delmaar & Bremmer (2009) include only four samples from which only one is a cleaning product (all-purpose cleaner).

- Inhalation cut-off diameter

The inhalation cut-off diameter is defined as the diameter below which the sprayed particles can be inhaled and reach the lower areas of the lungs, i.e. the alveolar region (Delmaar & Schuur, 2016). It is only an approximation of the complicated process of deposition of particles in the lung, but in practice, its value is suggested to be set at 10–15 μm (Delmaar & Schuur, 2016). In order to be conservative, the default for inhalation cut-off diameter is set here at 15 μm. The Q-factor is considered to be 3, because the value is specifically but qualitatively derived for the parameter inhalation cut-off diameter.

- Density non-volatile

The density of the non-volatile fraction is one of the parameters included in the spray model and is defined here as the density of the aerosol droplets that become airborne. Together with the droplet diameter, the aerosol density determines, the time that the aerosol droplet is airborne and therefore available for inhalation. Many ingredients in cleaning products are made of (very) large organic substances with densities between 1.0 and 1.5 g/cm^3. The density of salts generally varies between 1.5 and 3.0 g/cm^3. For a complex mixture of (organic) substances, the default density is set at 1.8 g/cm^3. The Q-factor is set to 3, because density is a physicochemical property that is evident for most substances, but it is presented here on a generic level (Table 4).

Table 4: Default values for density non-volatile substances (Prud'homme de Lodder et al., 2006a).

Main ingredient	Density (g/cm^3)	Q-factor
Large organic substances	1.5	3
Salts	3.0	3
Complex mixtures	1.8	3
Density data lacking (non-volatile)	1.8	3

- Oral non-respirable material exposure

Non-respirable oral exposure is expected from material in aerosol particles with a diameter larger than the inhalation cut-off. Particle of this size are deposited in the higher regions of the respiratory tract, so that they are taken up orally. ConsExpo offers the option 'include oral non-respirable material exposure'. If this option is checked, ConsExpo adds an oral route model to the exposure scenario and accounts for the non-respirable fraction of the inhaled spray. By default the option is not 'included' for cleaning sprays, because the larger particles are most prone to deposit to the surface to which the spray is directed.

Dermal

In this general scenario of exposure to spray applications the ***dermal – direct product contact - constant rate*** of ConsExpo Web is used to calculate the dermal exposure from spray applications that are directed towards a surface. The generic exposure scenario for such dermal exposure to substances from spray applications provides explanation for interpretation of contact rate and release duration. Defaults are derived for contact rate only.

- Contact rate- aerosol spray cans

ECHA (2015a) provides data for consumer spray products available as pre-pressurized aerosol spray cans and hand-held trigger sprays, e.g. consumer product spraying and dusting model developed by the UK Health Safety Laboratory (HSL) in 2001. This non-professional surface spraying model for indoor surfaces describes the use of pre-pressurized aerosol spray cans, e.g. for in skirting, shelves and horizontal/vertical laminate surfaces. The model calculates a 75th percentile of 64.7 mg/min for dermal exposure on hands and forearms and for legs/feet and face a 75th percentile of 35.7 mg/min is provided, so that the total contact rate for the use of aerosol spray cans is 100 mg/min. Hence, the default for contact rate – aerosol spray cans is set at 100 mg/min. The Q-factor is 3, because the underpinning data is quantitatively rich but not specifically collected for cleaning products available in aerosol spray cans.

- Contact rate - trigger sprays

For the use of hand-held trigger sprays, ECHA (2015a) describes a non-professional surface spraying model for spraying indoors in small rooms, i.e. sofa skirting, dining chairs and carpets. The 75th percentile for contact rate after dermal exposure on hands and forearms is 36.1 mg/min and for legs/feet and face is 9.7 mg/min yielding a total contact rate for trigger sprays of 46 mg/min. Hence, the default for contact rate for trigger sprays is set at 46 mg/min with a Q-factor of 3. The Q-factor is 3, because the underpinning data is quantitatively rich but not specifically collected for cleaning products available as trigger sprays.

- Release duration

Dermal exposure is expected to occur both during the actual spraying event and the time between spray events. Release duration should therefore be equal to the intermittent spray duration in case spraying is not continuous.

4.2.2 *Generic exposure scenario for surface cleaning*

There are many different consumer products on the market that are used to clean surfaces. For example specific cleaning products such as kitchen, oven, bathroom, and toilet cleaners are developed to treat a specific surface. Other examples besides cleaning products are surface specific waxes and polishes. Although all of these products are developed to treat different surfaces, the activities the consumer needs to perform to treat these surfaces are actually quite similar:

- Applying the product to the surface
- Leave the product on the surface to soak
- Removing the product from the surface

Exposure should then be calculated as the sum of the exposures resulting from these activities. Inhalation exposure to volatile substances in sprays is the exception here, because it is assumed that these substances are instantaneously and fully airborne during the spray application. Hence, it is assumed all substance is already released to the air, so that the instantaneous release also covers the evaporation during the leave-on period. Consequently, adding airborne substances from evaporation during leave-on to the sum of inhalation exposure would yield an overestimation.

4.2.2.1 Surface application

Four different ways are considered for applying a product onto a surface: with a spray (4.2.1), a wet (impregnated) tissue (wipe), and with a cloth or mop. Cloth and mops are used to clean medium to large surface areas. They absorb liquids, gels, creams, and diluted products, whereas ready-to-use products (such as wet wipes) are impregnated with such products. There are two ways considered to apply a product to a surface with a cloth: the cloth itself can be wetted and then rubbed over the surface, or the surface is wetted and then a dry cloth is used to spread out the product over the entire surface.
The generic exposure scenario for surface application comprises the pouring and spreading out of the product over the surface. The scenario

defaults as described in the sections below are used to predict inhalation and dermal exposure.

Inhalation -wet cloths, mops and tissues
In contrast to the 2006 version of the Cleaning Products Fact Sheet (Prud'homme de Lodder, et al., 2006a), the ***exposure to vapour – evaporation – increasing release*** is now used to estimate inhalation exposure for surface application with cloths, mops, and wet tissues as the surface area increases during application of the cleaning agents. Parameter values, however, are not generic, because they specifically depend on the type of surface that is treated, which can be product dependent. The exposure duration for this phase is limited to the application duration, as the remainder of the exposure is covered by a following leave-on period.

- Mass transfer coefficient

The mass transfer coefficient determines the transport of an evaporating substance from a product's surface to indoor air. Moreover, the mass transfer coefficient accounts for the fact that emission from a product is limited due to the presence of a stagnant layer of air over the product's surface through which the substance diffuses to reach indoor air. The mass transfer coefficient depends on a number of factors including the diffusivity of the substance through air (dependent on molecular weight), the air flow over the product, and the surface roughness of the product. In ConsExpo version 4.1, two models were provided to estimate the mass transfer coefficient, referred to as 'Langmuir's' and 'Thibodeaux's' method. These methods however, are suitable for outdoor conditions and give large over-predictions for indoor conditions. Typical estimated values are 500,000 m/h for Langmuir and 29 m/h for Thibodeaux (for a substance with molecular weight of 20 g/mol and at 20 °C). Estimation methods of mass transfer coefficients that are more representative for indoor conditions are presented below. Based on these methods a generic default value is suggested.
Several models have been developed and used to estimate mass transfer in indoor environments. Weschler and Nazaroff (2008) use a particle deposition model to derive typical mass transfer rates for semi-volatile organic compounds (SVOCs) from flat surfaces indoors to indoor air. This model uses information on the range of typical diffusivities of substances in air indoors to describe the mass transfer. They conclude that for the substances they considered, the mass transfer coefficient ranged from 2.5 to 3.9 m/h. The US-EPA Consumer Exposure Model (CEM) user's guide (US-EPA, 2016) proposes a method to estimate the mass transfer coefficient as:

$$h_m = 46.8 \times \frac{3.3}{(2.5 + MW^{1/3})^2}$$

Here, h_m is the mass transfer coefficient in m/h and MW the molecular weight in g/mol. This model takes only substance diffusivity of the substance (which depends on the molecular weight MW) into consideration. Using this model, based on variation in the molecular weight, a range of mass transfer coefficients can be estimated (see Table 5).

Table 5: Calculated mass transfer coefficient per molecular weight of the substance

Molecular weight (g/mol)	mass transfer coefficient (m/h)
20	5.7
100	3.0
300	1.8
600	1.3

In Delmaar (2010) a number of models to estimate the mass transfer coefficient for a flat surface have been reviewed. This review shows that these different models predict the mass transfer coefficient to be in a range between 2 and 16 m/h depending on the model used, the diffusivity of the substance in air (thus molecular weight) and the air flow over the surface. The different methods and models applied in literature indicate that the mass transfer coefficient is in the order of 1 to 10 m/h, where the previously used default methods (the models of Langmuir and Thibodeaux) result in much higher estimates. Therefore, a generic default value for the mass transfer coefficient of 10 m/h is proposed. This generic default is usable for a situation where specific properties of the substance, the product and the indoor environment are not considered. The Q-factor is set to 2, because of the generic and conservative character of the calculation from which the default is derived.

The ***exposure to spray – instantaneous release*** is used to estimate the exposure to volatile substances from cleaning products available on the market as sprays. The application duration is set equal to the exact spraying time, whereas the exposure duration is set at the duration a person remains in the room. The exposure duration is therefore dependent on the type of product in consideration. As this approach is overestimating the exposure to vapours considerably, it may be assumed that the instantaneous release also covers the evaporation during the leave-on period (4.2.2.2). Upon application it is assumed that all substance is released to the air. Hence, it is redundant to add substance to the air concentration from evaporation of the surface, leading to an overestimation.

Dermal
The dermal exposure for surface cleaning differs for the use of sprays, wet wipes or cloths and mops. Dermal contact to sprays is only expected from deposition of airborne aerosols (4.2.1) and when a cloth is used to spread out the product. Treating the surface with wet wipes leads to dermal exposure via contact between the hands and the wipe. Dermal exposure from cleaning surfaces with a cloth or mop may occur from dipping the forearms and the hands holding the cloth or mop while dipping it into a bucket with diluted product. Dermal exposure from dipping the cloth or mop in a bucket is considered similar to the generic exposure scenario of dilution of products (4.2.3). Additionally, hand contact with a wet cloth itself when the product is brought on the surface may also lead to dermal exposure. The ***direct product contact - instant application*** is used to estimate dermal exposure from hand contact with wet cloths and wipes. Generic interpretations or default parameter values for dermal exposure from surface application are

discussed for the product amount upon hand contact with cloths, mops and wipes.

- Product amount - wet cloth

The product amount that is available for dermal exposure from a wet cloth is derived using the following calculation. The product amount applied to the surface is diluted by wetting the surface with the wet cloth. In a small experiment it was observed that a wet surface holds 40 ml water per m^2. The total volume of water on the treated surface can thus be calculated by multiplying the surface area (m^2) with 40 ml/m^2. The concentration of the product in the water is equal the applied product amount (g) divided by the calculated total volume of water (ml). The volume of water that ends up on the hand palm of the consumer (2.25 ml) touching the wet cloth is calculated by multiplying the exposed area of one hand palm (225 cm^2) with a layer thickness of 0.01 cm (ECHA, 2015a). It is assumed that the product concentration in the water laying on the treated surface is equal to the concentration in the volume of water that is in contact with the hand palm, so that:

$$\frac{g_{product\ on\ surface}}{ml_{water\ on\ surface}} = \frac{g_{product\ on\ hand}}{ml_{water\ on\ hand}} = \frac{g_{product\ on\ surface}}{40\ ml \times surface\ area(m^2)} = \frac{g_{product\ on\ hand}}{2.25\ ml}$$

The default product amount available for dermal exposure by touching a wet cloth is then calculated by rearranging the equation above into:

$$g_{product\ on\ hand} = \frac{g_{product\ on\ surface}}{surface\ area(m^2)} \times \frac{2.25\ ml}{40\ ml}$$

The Q-factor for the defaults derived with this equation is set to 2, because the underlying data for the calculation is limited.

- Exposed area - mops

Also when the consumer uses a mop, it is assumed that there will be dermal contact with the diluted product by dipping the hands and forearms in the mop bucket. In the General Fact Sheet (Te Biesebeek et al., 2014) default values for surface area of the hands (900 cm^2) and forearms for adults (half surface area arms; 1300 cm^2) are described. The exposed area is therefore 2200 cm^2 (Te Biesebeek et al., 2014). The Q-factor for exposed area is set to 3, because the underpinning data is quantitatively rich, but compromised by assuming that the surface area of a forearm is half the surface area of a full arm.

- Product amount - mops

A volume of water of 22 ml that is in dermal contact upon dipping is then calculated by multiplying the exposed area (2200 cm^2, see above) with a layer thickness of 0.01 cm. The layer thickness applied here is taken from the Guidance on the EU Biocidal Product Regulation (ECHA, 2015a) in which a general layer thickness for liquid runoffs is set at 0.01 cm (4.1.2). The product amount is then calculated by multiplying the concentration of product in the mop bucket with the contacted water volume of 22 ml. The Q-factor for such a calculated parameter value is maximally 2, because that is the lowest Q-factor of the variables from which product amount is calculated (layer thickness).

- Product amount - wet wipes

The product amount for wet wipes is interpreted as the amount of the liquid cleaning product that migrates from the wet tissues to the skin of the consumer that touches the tissue firmly during the cleaning task. It is derived by multiplying the amount of product migrating from the use of one tissue multiplied with the number of tissues used in the cleaning task. The number of tissues used is based on the EPHECT survey (Annex II), where the 75^{th} percentiles are 3.2 for all-purpose wipes, 3.4 for bathroom wipes, 3.6 for kitchen wipes, and 3.8 for glass cleaner wipes. The amount of product migrating from a wet tissue is evaluated by Weerdesteijn et al. (1999) and Hossain et al. (2015). Weerdesteijn weighed wet tissues and determined that a mean amount of 0.044 g (st. dev.= 0.004 g, n=5) remained on the surface of the hand after firmly touching the tissue. Hossain et al. (2015) estimated dermal contact for a commercially available diaper wipe to be 0.5% of the weight of the total weight of the wipe (rounded mean weight 7.7 g and wiped amount 0.04 g per wipe). In the previous version of the Cleaning Product Fact Sheet (Prud'homme de Lodder et al., 2006a) a 75^{th} percentile of 0.047 g was described as 1.4 % of the weight of liquid product in the wipe. Based on a small experiment, it is determined that a wet tissue consists for 60% of the liquid cleaning product and 40% of the weight is the dry weight of the tissue. Multiplying the 75^{th} percentiles for the number of wipes in Annex II with the fraction of 0.5 % of liquid product that ends up on the skin (Hossain et al., 2015) and the 60% of the wipe that represents the liquid product fraction in the tissue, results in a range of 0.048-0.057 g for product amount in a wet wipe. This is consistent with the default in the previous version of the Cleaning Product Fact Sheet; the default product amount for dermal exposure therefore remains at 0.05 g with a Q-factor of 3, because it is underpinned with quantitatively rich data. Nonetheless, in a specific exposure scenario a specific product amount is preferred over the generic one.

4.2.2.2 Surface leave-on

After the product is applied to the surface the consumer may leave the product on the surface for a period of time. For example, cleaning products are left to soak. This activity of surface leave-on is not entirely independent from the way it has been applied (spray, wet tissue, cloth or mop), because the amount of product on the treated surface and the time required to soak may vary. Therefore, the default scenarios for surface leave-on are not overarching for all products. Rather, it is considered generic per way of application. During leave-on, inhalation exposure from substances evaporating from the surface is to be expected, whereas dermal exposure is not.

Inhalation
Inhalation exposure to substances evaporating from the surface is calculated with the ***exposure to vapour – evaporation – constant release***.

- Product amount - wet wipes

The product amount for wet wipes is interpreted here as the amount of product that is available for inhalation exposure, which in this scenario is the product amount that is left on the surface. Wet tissues or wipes are used for small cleaning jobs on all washable surfaces. Nonetheless, analysis of the EPHECT data (2015; Annex II) shows a 75th percentile for the number of wipes of 3.3 used for all-purpose wipes, bathroom wipes, kitchen wipes, and glass cleaner wipes. Weerdesteijn et al. (1999) measured the total weight of a wet wipe to range between 5.5 and 5.8 g. The dry weight of the wipes however ranges between 2.2 and 2.3 g, so that the actual weight of the wet product in the wipe is between 3.3 and 3.5 g. The default product amount for inhalation exposure is similar to the amount of wet product used, and is set at 11.5 g. The Q-factor is set to 3, because it is underpinned with quantitative but specific (non-generic) data.

4.2.2.3 Surface removal

It is assumed that the surface is cleaned with a (wet) cloth. Dermal exposure is considered equal to that of surface application with a cloth (4.2.4.1). In case the substance was applied with a wet wipe or mop, it is assumed that a removal step is not in place.

4.2.3 *Generic exposure scenario application of diluted products*

Many consumer products require dilution with water prior to application. This mixing process is especially necessary for the application of certain cleaning products such as dish washing, hand laundry, floor cleaners. During the application of these products dermal contact with the water in a bucket, sink, bowl, or flask is possible. Moreover, diluting the product with hot water may increase the evaporation and inhalation of volatile substances.

Inhalation
Inhalation exposure of water diluted products is calculated with the ***inhalation – exposure to vapour - evaporation – release area mode constant*** of ConsExpo Web (Delmaar & Schuur, 2016). The generic exposure scenario for product dilution with water addresses interpretation and defaults for the parameters release area, product amount and weight fraction dilution.

- Release area - buckets, sinks, and wash bowls

The release areas considered depend on the container of the water in which the product is diluted. Here the release areas of buckets, sinks, and wash bowls are derived from their dimensions. It is assumed that most consumers use a large bucket that is 50 cm long x 27 cm wide so that its surface area equals 1350 cm^2.
Weerdesteijn et al. (1999) calculated a 75th percentile of 1453 cm^2 for the surface area of sinks (n=18). Today's dimensions (cm) of rinse units of popular sinks are 41 cm long x 36 cm wide x 20 cm deep, so that the surface area equals 1453 cm^2. Prud'homme de Lodder et al. (2006a) set

EPA-HQ 2017-003964

the default at 1500 cm^2. Because of the minimal variation in the numbers, the default of release area resulting from sinks, buckets, and wash bowls remains at 1500 cm^2. The Q-factor is set to 3, because the description is generic and only underpinned by quantitative data for sinks.

- *"Dilution Factor"*

For products that are diluted with water it is necessary to correct for dilution in order to correctly simulate the evaporation of substances (Delmaar & Schuur, 2016). Such correction is done with a dilution factor that will be presented as a new feature in the ConsExpo Web tool in 2017. In the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006), this dilution factor is incorporated by converting the product amount into a 'product amount $_{dilution}$' , which is equal to the mass of water in which the product is diluted. For example, a squeeze of dishwash detergent of 7 g is diluted in a bowl of 5 l. The product amount then equals the squeeze of dishwash detergents (7 g), whereas the 'product amount $_{dilution}$' represents the amount of water in the sink which is 5 l in volume and thus 5 kg in mass. Consequentially, the weight fractions of substances in the product needed to be corrected to these 'product amounts $_{dilution}$' as well. Therefore, a 'weight fraction $_{dilution}$' is calculated as the ratio of the 'product amount' and the 'product amount $_{dilution}$'. In the example of the dishwash detergent, such a weight fraction dilution would be 7 g / 5 kg = 0.0014.
In the current Cleaning Products Fact Sheet the term "weight fraction $_{dilution}$" is replaced with the term "dilution factor" which refers to the ratio between the product amount (g) and the total mass of the substance (g) the product is diluted in.
Please note that 'dilution factor' will be presented as an additional parameter in the new feature of ConsExpo Web.

Dermal

The ***dermal – direct product contact - instant application*** is used to calculate the dermal exposure for dipping hands and forearms into a water container (e.g. bucket or sink) with the diluted product. The general exposure scenario for product dilution with water addresses interpretation and defaults for the exposed area and product amount.

- Exposed area

The exposed area is interpreted as the skin surface of the hands and forearms. In the General Fact Sheet (Te Biesebeek et al., 2014) default values for surface area of the hands (900 cm^2) and forearms for adults (half surface area arms; 1300 cm^2) are described. Chapter R15 of the REACH guidance (ECHA, 2012) describes a skin area of the arm/forearms of adult males and females of 1851 cm^2 (derived from US-EPA, 1997). In the HEEG opinion on exposure assessments for biocidal products (HEEG 2013) a default of 1961 cm^2 has been given. Here, the default value for the exposed area is set at 2200 cm^2 in agreement with the General Fact Sheet. The Q-factor is set to 3, because it is underpinned with quantitative data that however do not refer to the specific use of cleaning products.

- Product amount

The default product amount on the skin is calculated from the concentration of the product after dilution in a container such as a bucket, bowl or sink. This concentration is calculated by dividing the amount of product inserted in the container with the volume of water in the container. The volume of water in the container is 15 l, which is equal to the surface area (1500 cm^2, see release areas of buckets, sinks and wash bowls) multiplied with a water depth of 10 cm. The volume of water that comes in contact with the skin is 22 ml, since the surface area of the exposed skin (2200 cm^2) multiplied with the layer thickness of liquid film (0.01 cm; see 4.1.2) equals 22 ml. The product amount that comes in contact with the skin is then calculated by multiplying the concentration of the product in the water with the volume of water that comes in contact with the skin, calculated as follows:

$$g_{product\ on\ skin} = \frac{g_{product\ in\ container}}{l_{water\ in\ container}} \times l_{water\ on\ skin} = g_{product\ in\ container} \times \frac{0.022}{15}$$

The Q-factor for such a calculated parameter value is maximally 2, because that is the lowest Q-factor of the variables from which product amount is calculated (layer thickness).

- *Dilution factor*

*The 'dilution factor' for dermal exposure will be presented as an additional parameter in the new feature of ConsExpo Web. It refers to the ratio of the 'pure product amount' and the 'diluted product amount' that is on the skin. If for example the product is diluted in water, the dilution factor is equal to a product concentration expressed in $g_{product}$ per g_{water}. In the current fact sheet, dilution factors for dermal exposure are not explicitly presented. All external dermal exposure estimations are either done with the **dermal - direct product contact instant application** or **the dermal - direct product contact constant rate,** whereas dilution factor is not a parameter for these models. However in the consumer exposure scenarios that include applications of diluted products, the dilution factor is presented implicitly presented; the product amount that is in contact with the skin is calculated by multiplying the concentration of the product in the water with the volume of water that is on the skin of the consumer (see above). This concentration expressed in $g_{product}$ per g_{water} is actually equal to the 'dilution factor' which is in the previous Cleaning Products Fact Sheet also referred to as 'weight fraction $_{dilution}$' (Prud'homme de Lodder et al., 2006a). Please note that it is necessary to correct for the properties of water upon contact with diluted products when using other dermal exposure models prescribed in the current Fact Sheet, e.g. diffusion models.*

4.3 Secondary exposure (post application)

Secondary exposure is a result of residues of the product left behind after application. Such exposure may be to the person that used the product, but also to other persons. There are four general relevant secondary exposure routes to be considered:

- Rubbing-off
- Hand-to-mouth exposure

- Migration from textiles
- Ingestion from dishes

4.3.1 *Generic exposure scenario for rubbing-off*

Rubbing-off is considered the situation in which there is dermal contact to a surface (working top, floor) already treated with a product which results in exposure to the substance. In this post-application phase, young children are relatively highly exposed, due to their specific time-activity pattern (crawling on treated surfaces, hand-to-mouth contact), and relatively low body weight. In the current fact sheet, the exposure calculations are generally based on a one year old Dutch child for whom a 25th percentile body weight of 9 kg is taken as default (Te Biesebeek et al., 2014; Annex I). Within ConsExpo Web, dermal exposure from rubbing-off is estimated with the ***dermal - direct product contact - rubbing off*** model. Explanation, interpretation and defaults are given for the parameters dislodgeable amount, transfer coefficient, contact time, contacted surface and exposed area.

- Exposed area

Dermal exposure (of a child) to a substance via rubbing off can take place on any uncovered part of the skin, e.g. head, arms and hands, and legs and feet. The exposed area is based on a child wearing T-shirt and shorts, a napkin and no socks or shoes. The covered skin area (trunk) is 35.7 % (Te Biesebeek et al., 2014), so that the exposed area can be calculated as an uncovered fraction of the total body surface of a one year old child; 64.3% x 0.45 m^2 =0.3 m^2 (Te Biesebeek et al., 2014). The default for exposed area is therefore set at 0.3 m^2 with a Q-factor of 4, because the default specifically refers to the unprotected skin area of a child derived from a quantitatively rich data source.

- Transfer coefficient (TC)

The transfer coefficient (TC) was described by the US-EPA (1997; 2012) as "a measure of surface-to-skin residue transfer dependent on factors such as surface type and contact intensity". Another definition is "the ratio of exposure, measured in mass of chemical per time (e.g. µg/hr), to residue, measured in mass of chemical per surface area (e.g. µg/cm^2), with resulting units cm^2/hr". In the previous version of the Cleaning Product Fact Sheet, a default of 0.6 (m^2/hr) was used (Prud'homme de Lodder et al., 2006a), based on US-EPA (1997) documentation. US-EPA updated their transfer coefficient to 0.18 m^2/hr in 2012. This correction was based on the fact that the default was obtained by correcting the adult TC value with a factor for total body surface area differences between adults and children. The Ad hoc Working Group on Human Exposure to Biocides (HEAdhoc) recommended to use US-EPA's 75th percentiles of 0.78 m^2/hr for an adult, but to apply to correct for infants of 6-12 months old. After all, as mentioned in the EU BPR, infants are typically considered to be the target population in rubbing off scenarios. This resulted in a TC of 0.2 m^2/hr for children (HEAdhoc, 2016). In the current document the recommendations of HEAdhoc are taken into account resulting in transfer coefficients values of 0.2 m^2/hr for children and 0.78 m^2/hr for adults. The corresponding Q-factor is set to 3, because it is underpinned with quantitative but generic (non-specific) data.

- Dislodgeable amount and dislodgeable fraction ($F_{dislodge}$)

The dislodgeable amount is the amount of product applied on a surface area that is potentially rubbed off per unit of surface area (g/m^2). ECHA (2015a) gives an overview of transfer efficiencies for different types of surfaces. To calculate this amount the dislodgeable fraction is needed, which is defined as the fraction of product on the surface that is potentially rubbed off. A pilot study of the Health Safety Laboratory (HSL) on aerosols (cited in the Biocides Steering Group's report, 1998), describes a 10% value for the dislodgeable fraction from treated carpets. Based on the data of the more general HSL pilot Study, the default fraction of product that is dislodgeable is set at 30% (the average of the 1-60% range). The dislodgeable amount is then by default calculated by multiplying this fraction with the product amount (g) per contact surface area (g/m^2):

$$F_{dislodge} = 0.3\ \frac{product\ amount}{contacted\ surface}$$

The Q-factors for dislodgeable fraction and dislodgeable amount are set to 3, because they are underpinned with quantitatively rich data. Nonetheless, in a specific exposure scenario a specific dislodgeable amount rate is preferred over a generic one.

- Contact time (t)

The contact time is to be interpreted as the amount of time a treated surface is being rubbed by the exposed individual.

- Contacted surface (S_{area})

This is the area of the treated surface that can potentially be rubbed. In some cases the rubbed surface may be smaller than the treated surface, for example, when the treated surface is not entirely accessible. This is dependent of the product use, and will be discussed in Chapter 6 to 12.

4.3.2 *Generic scenario for hand-to-mouth exposure*

The ***oral - direct product contact -direct oral intake*** is used to calculate oral exposure from hand-to-mouth behaviour. The hands are the most probable part of the body and form about 20% of the total uncovered skin. When it is assumed that 50% of the product that ended upon the hands is taken in orally due to hand-to-mouth contact, this means that 10% of the external dermal exposure is ingested via hand-mouth contact (Bremmer et al., 2006b) leaving 90% of the total external dose available for dermal uptake. The ingested amount via hand-to-mouth contact is calculated by taking 10% of the total external dermal dose, see 4.3.1 (exposed area).

4.3.3 *Generic exposure scenario for migration from textile (adults)*

After washing, residues of laundry products may remain on clothing. While wearing these clothes, residues can migrate from textile to skin leading to dermal exposure. For estimating such secondary exposure the ***dermal - direct product contact - migration*** is used (Delmaar & Schuur, 2016). The amount of residue depends on the composition of the detergent, the substance, and the type of textile.

- Exposed area

The default for exposed area is set at 1.7 m^2, which equals the entire surface area of an adult human body minus head and hands (Te Biesebeek et al., 2014). It is not necessary to correct for the parts of the human body that are not covered with textile, because this already done in the derivation of the skin contact factor described below. The Q-factor is set to 4 based on the quantitative data in the General Fact Sheet (Te Biesebeek et al., 2014).

- Product amount -clothes

In a small experiment, individuals were asked to weigh their clothes (except shoes). Winter clothes worn simultaneously weigh 1382 g and summer garments were estimated at 932 g (based on the winter garment minus a sweater). The default product amount for adults is set at 1000 g. The Q-factor is set to 2, because the underpinning data is limited.

- Skin-contact factor

The skin contact factor (F_{skin}) is the fraction of the product that has actually contact with the bare skin. For calculation of F_{skin}, it is assumed that half of the clothes are in direct contact with the skin (F_{skin} = 1) and half has on and off contact with the skin (F_{skin} = 0.6). Overall, the skin-contact factor becomes 0.5 x 1 + 0.5 x 0.6 = 0.8 (Prud'homme de Lodder et al., 2006a). The default is set to 0.8. The Q-factor is set to 1, because the calculation strongly depends on expert judgement.

4.3.4 *Generic exposure scenario for ingestion of residues from dishes*

Oral exposure can occur due to residues left on the washed dishes. According to Weerdesteijn et al. (1999) the residue quantity increases with the detergent concentration or with the dishwater temperature. Larger amounts of residue are expected if the dishes are air dried. The ***oral – direct product contact – direct oral intake*** parametrization described below assumes that all dishes are air-dried (Delmaar & Schuur, 2016).

- Frequency

It is assumed that dishes are used every day for food and drinks. The default for frequency of use equals 365 times per year. The Q-factor is 4, because it is safe to assume that the dishes are used on a daily basis.

- Amount ingested

The amount ingested is calculated by multiplying the amount of water left on the dishes with the concentration of the product in the water. According to AISE (2002) the amount of regular dishwashing liquid used is between 3 and 10 g, whereas concentrated detergent is between 2 and 5 g (both per 5 l of water). Ramirez-Martinez et al. (2014) reported an average value of dishwashing liquid of 5.6 g (st. dev =5.7 g) in 8 l. The 75th percentile of 7 g per 5 l water found by Weegels remains the default value for liquid, which is supported by the data from AISE (2002) and Ramirez-Martinez et al. (2014). This gives a product concentration of 1.4 g/l. The Q-factor for the product amount is set to 4, because the underpinning data is specifically collected to assess the amount of product applied for dish washing. According to Schmitz (1973, adopted by HERA, 2005) the amount of water left on dishes is 5.5x10^{-5} ml/cm^2 and the area of dishes in daily contact with food is 5400 cm^2. The ingested product amount is then $5.5x10^{-5}$ ml/cm^2 x 5400 cm^2 x 1.4 mg/ml = 0.42 mg. ECHA (2015a) also uses above defaults and calculations. The default for amount ingested remains at 0.42 mg. The Q-factor for ingested amount is set to 2, because the data underpinning the daily contact with dishes is limited.

5 New information after 2006

New information was collected from scientific literature, product information labels, industrial and government reports and surveys in order to reconsider the defaults of the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a). Important sources of new information published since 2006 leading to reconsideration of the defaults are discussed below.

5.1 EPHECT Survey

The EPHECT project ("Emissions, Exposure Patterns and Health Effects of Consumer Products in the EU") is a European collaborative project, co-funded by the European Union, in which important information has been gathered about the use of cleaning products by European consumers (EPHECT, 2015). The EPHECT survey was performed in 2012 (EPHECT, 2012) and published in 2015 (Dimitroulopoulou et al., 2015a, b; Trantallidi et al., 2015). It was designed to collect household use data for 16 consumer products across four geographical regions of Europe. A total of 4335 people from ten European countries were interviewed, i.e. Czech Republic, Germany, Denmark, Spain, France, Hungary, Italy, Poland, the UK and Sweden. Eight of the 16 considered products were cleaning products, namely all-purpose cleaners, kitchen cleaners, floor cleaners, glass and window cleaners, bathroom cleaners, furniture and floor polish products, and coating products for leather and textiles. Also raw data for the use frequency (per year) and the amount of product used per event (g) was provided by the EPHECT team (2015). For the purpose of this fact sheet, the raw data were analyzed with a Monte Carlo simulation in order to derive probabilistic distributions for use frequency and product amount. In Table A3 (Annex) the conversion of the data to product amount has been described. For more information see Annex II. The Q-factor for the EPHECT data was in general set at 4, given the high number of survey participants from different EU countries and recentness of the study.

5.2 AISE surveys

The International Association for Soaps, Detergents and Maintenance Products (AISE) and the Committee of the European Chemical Industry Council (CEFIC) have conducted a survey in 2002 in order to collect data on the habits and practices of European consumers in using cleaning agents. The data delivered by AISE refer to the use of laundry detergents, fabric conditioners, laundry additives, dishwashing agents, surface cleaners and toilet cleaners. Summary results of the survey are reported as minimal, maximal and typical frequencies, used amounts and task durations within the HERA (Human and Environmental Risk Assessment) Project in 2002 and published in 2005 (HERA, 2005). Defaults in the previous version of the Cleaning Product Fact Sheet (Prud'homme de Lodder et al., 2006a) that refer to the AISE table of habits and practices (AISE, 2002) are used again in this version if more appropriate information has not become available ever since.

Additional data has been collected by AISE in 2009 for laundry aids, insecticides, water softeners, maintenance products, wipes, drain granules, high pressure washers/cleaners and air fresheners. The summary results for these products are available on the website of AISE (AISE, 2009; archived in 2014) and are consulted in this fact sheet for deriving new defaults. Besides the quantitative information collected in 2002 and 2009, AISE also performs a qualitative survey every three years since 2008 (AISE, 2015). In this survey it is questioned whether consumer awareness of sustainability leads to adapted behavior in the use of cleaning agents. However, the presented data is rather qualitative (AISE, 2015) and is therefore less suitable for deriving new defaults referring to habits and practices of European consumers in using cleaning agents.

5.3 Consumer information websites

In addition to the data from abovementioned recent projects, new and relevant information was taken from official consumer information websites from industrial or governmental organizations.
Product information such as ingredients and compositions of laundry and dishwashing detergents as well as sanitary and surface cleaning agents is collected from www.isditproductveilig.nl. This website is an initiative of the Dutch Association of Soap Manufacturers (NVZ) to inform consumers about safe use of cleaning products.
The website www.cleanright.eu also shares ingredient and composition information of laundry, dish and household cleaning and maintenance products. Cleanright (2016) is a service provided to consumers to help them understand the broad range of cleaning and maintenance products available. The website is an initiative of the two European industry associations AISE and CEFIC.
The American Cleaning Institute's website www.cleaninginstitute.org provides composition and ingredient information of cleaning product as well as relevant context information about the function and chemical structures of these ingredients (ACI, 2016).

5.4 Experimental evaluation of critical parameters of the ConsExpo spray model

A series of experiments on propellants and trigger sprays has been performed in 2009 in order to validate and calibrate the spray models included in ConsExpo (Delmaar & Bremmer, 2009). Two critical exposure parameters for spray products are the mass generation rate of the product, and the size distribution of the generated particles. These parameters have been experimentally determined for 23 spray cans and trigger sprays. Mass generation rates were determined by spraying for 10 seconds (spray cans) or squeezing 10 times (trigger spray; squeezing 10 times takes approximately 6 seconds) and determining the weight loss of the spray.
Particle size distributions were determined by light scattering experiments using the Mastersizer S (Delmaar & Bremmer, 2009). The study included products from different product groups including pest control products, personal care products, cleaning products, paints.

Information from the experiments is used to derive defaults for mass generation rates and particle size distributions for aerosol spray cans and trigger sprays for the different product categories.
The default mass generation rates described in the Fact Sheets generated in 2006 have been updated in 2010 in ConsExpo 4.1, based on the experimental measurements of Delmaar & Bremmer (2009).
In the previous version of the Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) mass generation rates of sprays are defined as the mean mass generation rate over the total time span of the spraying task. This required the mass generation rates of Delmaar & Bremmer (2009) to be adjusted by averaging over the total time span (RIVM, 2010). In the current version of the Cleaning Product Fact Sheet a different approach is adopted. In contrast to the 2006 version, the mass generation rate is defined as the mass generated during the net spraying time. Using this definition, the mass generation corresponds directly to the generation rates determined in the experiments described in Delmaar & Bremmer (2009) (Annex I Table A2).

5.5 The ETH survey on the use of different consumer products

The Federal Technical University (ETH) of Zürich conducted a survey in Switzerland to assess consumer usage patterns (Garcia-Hidalgo et al., 2017). The use-patterns of 12 household care products, 5 laundry products, and 22 personal care products were collected among the Swiss population (n =759; ages 0-91) by postal questionnaire. The survey was designed to collect data with respect to the use frequency, quantity, duration, and habits, and co-uses of household and personal care products. Based on the summary data of this study, 75th percentiles are derived and used in the current fact sheet for the frequency and duration of consumers using various products. Examples are hand wash laundry and dish wash detergents, as well as all-purpose, toilet, kitchen, bathroom, carpet, glass, floor, and furniture cleaners. The 75th percentiles are derived from the data tables that express the percentages of the multiple choice answer per sex and age group. The number of respondents for each subgroup is also given, which enables the recalculation of the percentage and thus percentiles for the adults of the survey population (n=611). The 75th percentiles derived for the current fact sheet should be interpreted as "the multiple choice answer that the respondent reflecting the 75th percentile would declare". For some products it is clear that there is a distinction between respondents that never use the product (non-users) and respondents that use the product regularly. For these products (kitchen, bathroom and glass cleaner) it is decided to exclude the non-users in the calculation of the 75th percentile.

5.6 Other

Information from other sources leading to reconsideration of specific defaults is discussed above the respective tables presenting the default values.

6 Laundry products

Laundry products are detergents for cleaning textiles. The products can be discriminated based on their function, e.g. all-purpose or light-duty detergents. All-purpose detergents are suitable for all washable fabrics while light-duty detergents are designed for lightly soiled items and delicate fabrics. Many detergents are concentrated. For environmental beneficial purposes they are available in much smaller packages and less detergent is needed for the same cleaning process.
Laundry detergents are available as powders/granules, liquids, tablets, gels, sticks, aerosol sprays, and as pump sprays.

Exposure to substances in laundry products can occur through:
- Inhalation of detergent dust, aerosols or inhalation of volatile compounds
- Direct dermal contact with undiluted or diluted laundry products
- Ingestion of detergent residues through mouthing of textiles by children
- Indirect dermal contact via release of chemicals from textiles to the skin.

Laundry Detergent Powders
Detergent powders are used to facilitate the manual or mechanical washing of clothing with water. Loading a washing machine (or bucket) with laundry powder is executed either by pouring straight from the package or by using a measuring spoon. Both methods lead to generation of dust particles and consequentially to both inhalation and dermal exposure. Table 6.1 gives an overview of the general composition of laundry detergent powders.

Table 6.1: General composition of laundry detergent powders (www.isditproductveilig.nl)

Laundry products powders	All purpose %	Colour %	Delicate %
Surfactants			
Anionic	5-10	5-15	10-20
Non-ionic	±5	5-10	1-10
amphoteric	-	-	0-2
Builders			
Alkalis			
-sodium carbonate	5-30	5-25	10-50
-sodium silicate	<10	5-10	<5
Ion exchangers			
-zeolite	25-35	20-40	15-60
-polycarboxylate	0-5	0-5	1-5
Complexing agents			
-citric acid / citrate	0-5	0-10	0-10
-phosphonates	0-0.5	0-0.5	-
Bleaching agents			
Sodium perborate/percabonate	5-15	-	-
TAED	2-6	-	-
Additives			
Optical brighteners	0.1-0.2	-	-
Dye transfer inhibitor	-	0.5-2	0.5-2
Sodium sulphate	<5	<5	2-40
Enzymes	<2	<2	0-2
Anti-redeposition agents	0-2	0-2	0-2
Foam inhibitors	0-0.1	0-0.1	0-0.1
Fragrances	0-1	0-1	0-1
Dyes	0-0.1	0-0.1	0-0.1

Laundry Detergent Liquids
Similar to powders, detergent liquids are used to facilitate the manual or mechanical washing of clothing with water. Loading a washing machine/bucket/sink with a laundry liquid is executed either pouring straight from the bottle or by using a measuring cup. During loading with laundry liquids, spills may occur that may lead to dermal exposure and inhalation exposure of volatile substances. Table 6.2 gives an overview of the general composition of laundry detergent liquids.

Table 6.2: General composition of laundry detergent liquids (www.isditproductveilig.nl)

Laundry products liquids	All purpose %	Colour %	Delicate %
Surfactants			
Anionic	5-25	5-25	0-25
Soap	5-25	5-25	0-5
Non-ionic	5-30	5-30	10-20
Builders			
Alkalis			
-sodium carbonate	0-1	0-1	-
Ion exchangers			
-polycarboxylate	-	-	0-5
Complexing agents			
-citric acid / citrate	3-5	3-5	0-1
-phosphonates	0-1	0-1	-
Solvents			
Alcohol	1.5-10	1.5-10	0-15
Additives			
Optical brighteners	0-0.1	-	-
Dye transfer inhibitor	-	0-1	0-1
Enzymes	< 2	< 2	0-2
Preservatives	0.1	0.1	< 1
Thickening agents	-	1-5	1-5
Foam inhibitors	0.1	0.1	-
Fragrances	0-1	0-1	0-1
Dyes	0-0.1	0-0.1	0-0.1
Water	rest	rest	rest

Tablets and capsules
The latest developments in laundry detergents are tablets and capsules (caps). They are suited for one machine wash and need to be placed in the washing machine. Dermal exposure may occur during the removal of the foil wrapped around the tablet. Plastic wrapping foils must be removed, but most foils are water soluble. Exposure from tablet/capsule use during mixing and loading is therefore considered negligible, because it is a ready-to-use product (see 4.1.3). Furthermore, no exposure is expected during the application phase, because the product is in an enclosed washing machine, whereas secondary exposure from migration of textile is considered generic (see 4.3.3). Therefore, specific exposure from laundry detergent tablet/capsules is not further discussed in this chapter.

Conditioners
Fabric conditioners are used to soften the textiles after washing. In addition, they prevent synthetic textiles to become statically charged and ease ironing. They often give a nice scent to the washed fabric. Fabric conditioners can be purchased as ready-to-use liquids or as wet wipes. Also, laundry detergents are available with built-in conditioners (2 in 1 products). The softening substances mostly used are bentonite and cellulase. Exposure is considered similar to the use of laundry liquids into washing machines. Table 6.3 gives an overview of the general composition of fabric conditioners.

Table 6.3 General composition of fabric conditioners (www.isditproductveilig.nl)

Fabric conditioners	%
Surfactants	
-cationic	< 25
-non-ionic	0-4
Solvents	
-alcohol	0-2.5
Additives	
Preservatives	< 1
Dyes	0-0.1
Fragrances	< 1
Water	Rest

6.1 Washing machine laundry detergent powders and liquids

Scenarios for consumer exposure
The exposure scenarios of laundry detergent powders and liquids only deviate from each other upon loading the product in the washing machine (4.1.1. vs. 4.1.2). Filling the washing machine with laundry powder may lead to the generation of inhalable aerosols that may also deposit onto the skin (4.1.1). Upon loading the washing machine with a liquid detergent, the consumer pours the liquid directly into the machine or fills a measuring cup which is then placed in the machine. Inhalation exposure is expected during opening the bottle containing the liquid, since volatile substance may evaporate into the consumers breathing zone. Additionally, in case of pouring liquids, spills (droplets) end up on the backside of the hand directing the bottle to the machine (4.1.2). Further, the exposure scenarios for liquid and powder laundry detergents are considered to be similar, with respect to their use frequency and location of exposure (the bathroom). Exposure during the application phase is assumed negligible for machine washing, because the product powder or liquid is in an enclosed machine. After washing, the consumer hangs the laundry to dry. The consumer is then dermally exposed by touching wet clothes that contain residue of the laundry product. Meanwhile, volatile substance may evaporate from the wet clothes as well, leading to inhalation exposure. Once the clothes are dry, there is still residue left on the clothes. Secondary exposure is expected from wearing clothes with laundry product residues that migrate from the textile to the skin.

6.1.1 *Mixing & Loading: Loading machine wash powders*

The aerosol exposures from loading laundry detergent powders are estimated with the ConsExpo ***inhalation – exposure to spray-instantaneous release mode*** and the ***dermal direct product contact – constant rate loading*** mode (4.1.1). Defaults for the parameters exposure duration, release duration, product amount for inhalation exposure, room volume and dermal contact rate are according to the generic scenario for loading powders (4.1.1).

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 365 times per year. Data from the US-EPA (1989) indicates a frequency of 0.22 to 1.90 times per day (weighted mean of 1.32 per day) based on their national human exposure assessment survey. AISE (2015) indicates that the estimate derived from survey data in 2002 (AISE, 2002) also suits more recent information on the frequency of machine wash use as a typical frequency of 5 times per week (range between 1 and 21 times per week). Kruschwitz et al. (2014) present a detailed graph for washing frequencies for German households consisting of 1 to 5 persons or more. The average frequencies for the two latter groups were 5.3 and 6.8 times per week. Laitala et al. (2012) also present washing frequencies for Norwegian households with an average of 8.3 per week for a 4-person household. A default value of once a day seems to represent a reasonable estimate that agrees with all of the different data sources. Therefore the default of 365 per year remains unaltered. A Q-factor of 4 is in place, because it is based on quantitatively rich data from multiple sources that specifically refer to the frequency of laundry tasks.

- Product amount -inhalation

According to section 4.1.1, the inhalation default for powder dust is 8.3 µg per 200 g used. According to AISE (2002), the amount of washing powder per wash event varies between 20 to 290 g, whereas the typical amount used for regular laundry powder is 150 g and 75 g for compact powder. Kruschwitz et al. (2014) presents averages ranging from 64 to 74 g of powder. A higher amount of 150 g per task however is more conservative but still reasonable. The default for regular powders is therefore adjusted to 6.2 µg based on a loading of 150 g, whereas the default for compact powders is adjusted to 3.2 µg based on a loading of 75 g. The Q-factor is set to 1, because the different data sources do not agree with each other.

Table 6.4: Default values for loading laundry detergent powders into a washing machine

Default value		Q-factor	Source
General			
Frequency	365 per year	4	AISE, 2002 & 2015; Kruschwitz et al., 2014; Laitala et al., 2012; US-EPA, 1989)
Inhalation -exposure to spray- instantaneous release			
Exposure duration	0.25 min	3	Section 4.1.1
Product amount			
Regular Powder	6.2 µg	1	See above.
Compact Powder	3.1 µg	1	See above
Room volume	1 m^3	1	Section 4.1.1
Ventilation rate	2 per hour	3	Bathroom (Te Biesebeek et al., 2014)
Dermal - direct product contact- constant rate loading			
Contact rate	5 mg/min	3	Section 4.1.1
Release duration	0.25 min	3	Section 4.1.1
Exposed area	225 cm^2	3	One handpalm (Te Biesebeek et al., 2014)

6.1.2 *Mixing & Loading: Loading machine wash liquids*

For exposure estimation during loading of liquids for machine washing the ConsExpo ***inhalation – exposure to vapour - evaporation - evaporation*** and the ***dermal – direct product contact - instant application loading*** are used (4.1.2). Defaults for the parameters product amount for inhalation and dermal exposure, room volume, release area, and exposed area are according to the generic scenario for loading liquids (4.1.2). As described in the scenario, the use frequency of laundry detergent liquids is considered equal to that of powders. Below defaults specifically derived for loading laundry detergent liquids are described.

- Application duration

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 0.27 min, based on the 75th percentile for filling a dishwashing machine with a polishing liquid (Weegels, 1997). For this, the consumer pours the product into a small box located at the inside. Filling a cup with liquid laundry detergent is considered to be a similar activity. The default application duration is therefore set at 0.3 min. The Q-factor is 3, because it is derived from quantitative data that is however not specific to loading liquids in a washing machine.

- Exposure duration

Exposure duration is considered here the time required to fill a cup with laundry detergent liquid and to empty the cup in the machine. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 0.75 min as maximal exposure duration for filling a dishwasher, based on Weegels (Weegels, 1997). AISE (2002) presents the task as 'less than 1 minute', which seems be in agreement with the previous. The default remains 0.75 min. The Q-factor is 3, because it is derived from quantitative data that is however not specific to loading liquids in a washing machine.

- Molecular weight matrix

In the previous Cleaning Products Fact Sheet the fraction of water in the liquid is estimated to be 20% (Prud'homme de Lodder et al., 2006a). No new data was found (Table 6.2), so the default for molecular weight matrix remains at 18 / 0.2 = 90 (g/mol). The Q-factor is set to 2, because the underpinning data is limited.

Table 6.5: Default values for laundry detergent liquids loaded into a washing machine

Default value		Q-factor	Source
General			
Frequency	365 per year	4	Section 6.1.1.
Inhalation - exposure to vapour- evaporation			
Exposure duration	0.75 min	3	AISE, 2002; Weegels, 1997
Product amount	500 g	3	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	2 per hour	3	Bathroom (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Application duration	0.3 min	3	Section 4.1.2
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	90 g/mol	2	Delmaar & Schuur, 2016
Dermal - direct product contact -instant application loading			
Exposed area	225 cm^2	3	One handpalm (Te Biesebeek et al., 2014)
Product amount	0.01 g	3	Section 4.1.2.

6.1.3 *Application: Hanging machine washed laundry*

Exposure to laundry products from hanging up the laundry is estimated with the ***dermal - direct product contact -instant application*** and the ***inhalation -exposure to vapour-evaporation -increasing release area***. Note, that inhalation exposure here is only relevant for the evaluation of volatile substances.

- Application duration

The application duration is considered here the time required to hang the laundry. By expert judgement it is determined that this takes approximately 15 min to hang 5 kg of laundry. The default is thus 15 min. The Q-factor is set to 1, because the default is based on expert judgement only.

- Exposure duration

Inhalation exposure occurs throughout the task duration for hanging up the laundry. Additionally, it is assumed that the consumer stays 5 min in the room once the laundry hangs. The default exposure duration is therefore 20 min, but with a Q-factor of 1 because it relies on expert judgement only.

- Product amount -inhalation

The product amount that is available for inhalation is calculated as the amount of laundry product that is still in the wet laundry after washing.

This calculation is performed with the amount of laundry product inserted in the washing machine, the volume of water in wet laundry as well as the volume of water a washing machine uses per wash event. A standard washing machine approximately uses 50 l water per wash event (Milieu Centraal, 2017). A wash event with a machine consists of 3 cycles, (2 wash and 1 rinsing), so that about 17 l is used per cycle (Miele, 2016). During each cycle, about 5 l of the water remains in the textile. This 5 l is estimated from the dimensions of the condense draw in a dry tumbler (Parts.nl, 2016). Consequentially, 12 l water remains in the machine per cycle.
The concentration of product in the water of the wet textile is equal to the concentration of product in the water of the washing water, so that:

$\frac{g_{product\ (wm)}}{l_{water(wm)}} = \frac{g_{product(tex)}}{l_{water(tex)}}$, and $g_{product(tex)} = g_{product\ (wm)} \frac{l_{water(tex)}}{l_{water(wm)}}$

The amount of laundry detergent product in the wet textile ($g_{product(tex)}$) is thus calculated as the amount of laundry product inserted in the washing machine (($g_{product(wm)}$) multiplied with the ratio between the volume (*l*) of water in wet textile ($l_{water(tex)}$) and the volume of water (*l*) used in the washing machine ($l_{water(wm)}$). Using the equation above to calculate the product amount that remains in the textile after 3 cycles gives 3.8 g (Table 6.6).The Q-factor is set to 2, because the underpinning data is limited.

Table 6.6: Calculation of laundry detergent product amount in textile and machine wash water per cycle

Cycle	Product amount (total)	Concentration in machine water	Product amount in machine water (g)	Product amount in textile (g)
1	150 g	150 g /17 l =8.82 g/l	12 l x 8.82 g/l = 106 g	5 l x 8.82 g/l = 44 g
2	44 g	44 g /17 l = 2.59 g/l	12 l x 2.59 g/l = 31 g	5 l x 2.59 g/l = 13 g
3	13 g	13 g /17 l =0.77 g/l	12 l x 0.77 g/l = 9.2 g	5 l x 0.77 g/l = 3.8 g

The calculated product amount that is available for inhalation derived in Table 6.6 refers to a use amount of 150 g of regular powder. The product amounts for different laundry detergents are calculated with the same approach are summarized in Table 6.7.The Q-factors are set to 2, because the calculation is not entirely based on expert judgement but lacks underpinning with quantitative data.

- Dilution factor

The dilution factor refers to the ratio of the product amount and the total mass of the substance in which it is diluted (4.2.3). Here, the product is diluted in the water that remains in the textile after the machine wash which is estimated to be 5 l in volume and thus 5 kg in mass, see above. Hence, the dilution factors for the different laundry detergents are calculated by dividing their product amounts with 5 kg of water (Table 6.7). The Q-factors are set to 2, because the calculation is not entirely based on expert judgement but lacks underpinning with quantitative data.

Table 6.7: Product amounts available for inhalation and dilution factors for different laundry detergents

Detergent	Amount used per machine wash	Product Amount	Dilution Factor
Regular powder	150 g	3.8 g	0.00076
Compact powder	75 g	1.9 g	0.00038
Regular liquid	150 g	3.8g	0.00076
Compact liquid	90 g	2.3 g	0.00046
Tablet[1]	75 g	1.9 g	0.00038
Capsule[2]	90 g	2.3 g	0.00046

1: Assumed equal to compact powder
2: Assumed equal to compact liquid

- Release Area

The scenario prescribes a washing event with 5 kg of laundry. The specific surface area of cotton is about 20 cm^2 per g, so that 1 m^2 textile weighs about 0.5 kg (Corea et al., 2006) and the area of 5 kg laundry is about 10 m^2. The specific surface area includes the both sides of the textile from which volatile substances may evaporate while hanging to dry. Hence, the default release area is calculated to be 10 m^2. The Q-factor 2 is, because the calculation lacks underpinning with quantitatively rich data.

- Exposed area

Both hands of the consumer are in full contact with the wet laundry. The exposed area is thus calculated as 2 x 450 cm^2 (Te Biesebeek et al., 2014) which is equal to 900 cm^2. The Q-factor is set to 3, because the data set provides sufficient quantitative data for the estimation of the size of one hand palm.

- Product amount -dermal

The product amount available for dermal exposure is calculated by multiplying the concentration of detergent in the water sorbed by the textile (0.77 g/l, see Table 6.6) with the volume of water that ends up on both hands of the consumer. The volume of water on the hands is 9 ml which is calculated by multiplying the exposed area of both hands (900 cm^2) with a layer thickness of 0.01 cm (4.1.2). The calculated product amount that is available for dermal exposure for different laundry detergents is summarized in Table 6.8.

Table 6.8: Product amount available for dermal exposure for different laundry detergents

Detergent	Amount used per machine wash	Product Amount
Regular powder	150 g	6.9 mg
Compact powder	75 g	3.5 mg
Regular liquid	150 g	6.9 mg
Compact liquid	90 g	4.2 mg
Tablet[1]	75 g	3.5 mg
Capsule[2]	90 g	4.2 mg

1: Assumed equal to compact powder
2: Assumed equal to compact liquid

The Q-factors are set to 2, because the underpinning quantitative data is limited.

Table 6.9: Default values for hanging up the laundry

	Default value	Q-factor	Source
General			
Frequency	365 per year	4	Section 6.1.1
Inhalation - exposure to vapour- evaporation- increasing release area			
Exposure duration	20 min	1	See above
Product amount			
Regular powder	3.8 g	2	See above
Compact powder	1.9 g	2	See above
Regular liquid	3.8 g	2	See above
Compact liquid	2.3 g	2	See above
Tablet	1.9 g	2	See above
Capsule	2.3 g	2	See above
Dilution factor			
Regular powder	0.00076	2	See above
Compact powder	0.00038	2	See above
Regular liquid	0.00076	2	See above
Compact liquid	0.00046	2	See above
Tablet	0.00038	2	See above
Capsule	0.00046	2	See above
Room volume	20 m^3	3	Unspecified room (Te Biesebeek et al., 2014)
Ventilation rate	0.6 per hour	3	Unspecified room (Te Biesebeek et al., 2014)
Release area	10 m^2	2	See above
Application duration	15 min	1	See above
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal - direct product contact -instant application loading model			
Exposed area	900 cm^2	3	Both hands (Te Biesebeek et al., 2014)
Product amount			
Regular powder	6.9 mg	2	See above
Compact powder	3.5 mg	2	See above
Regular liquid	6.9 mg	2	See above
Compact liquid	4.2 mg	2	See above
Tablet	3.5 mg	2	See above
Capsule	4.2 mg	2	See above

6.1.4 *Secondary exposure: Wearing machine washed clothes*

For estimating the secondary exposure the ConsExpo ***dermal - direct product contact - migration*** model is used (Delmaar & Schuur, 2016). Defaults for the parameters product amount and skin factor are according to the generic scenario for migration of residues from textile (4.3.3). The leachable fraction is discussed below. Note, secondary exposure is not relevant for (non-encapsulated) volatile substances, because those would have evaporated when the cloths were hung to dry.

- Leachable Fraction

The leachable fraction is interpreted here as the fraction of a substance in a laundry product that is able to leach from worn cloths to the skin of the person wearing the cloths. The leachable fraction is calculated by multiplying the residual amount in cloths with the fraction of the product that is prone to migrate to skin. The residual amount is equal here to the amount of product in the clothes at the moment they are taken out of the washing machine. In the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) it was assumed that 50% of the residual amount in cloths is prone to migrate to the skin of the person wearing these cloths. Corea et al. (2006) however, assumed that 10% of the residues on a washed fabric can migrate from cloths to skin. This was a worst case estimate based on personal communication with laundry detergent producers (Corea et al., 2006). Since, the reference source of the assumed migration rates of Corea is directly communicated from industry; it is applied in the calculation of a new default for the leachable fraction. Hence, the calculation of the leachable fraction for regular powders is:

$$FR_{leach(regular\ powders)} = \frac{g_{product(tex)}}{kg_{textile}} FR_{migration} \times W_f = \frac{15}{5} \times 10\% = 0.3\ g/kg\ \times W_f$$

Note this 0.3 g/kg refers to the leachable fraction of the entire laundry product. Hence, for evaluation of one (non-volatile) substance in the product, the leachable fraction should be multiplied with the weight fraction of the substance in the product. Table 6.10 gives an overview of the leachable fractions of all laundry detergents derived with the above described approach. The Q-factor is set to 1, since it strongly depends on the expert judgement opinion for migration rates even though it is directly communicated by a laundry detergent producer.

Table 6.10: Leachable fraction per type of laundry detergent in machine washing

Detergent	Amount used per machine wash	Leachable Fraction
Regular powder	150 g	0.076 g/kg x W_f
Compact powder	75 g	0.038 g/kg x W_f
Regular liquid	150 g	0.076 g/kg x W_f
Compact liquid	90 g	0.045 g/kg x W_f
Tablet[1]	75 g	0.038 g/kg x W_f
Capsule[2]	90 g	0.045 g/kg x W_f

1: Assumed equal to compact powder

2: Assumed equal to compact liquid

- Exposed area

The exposed area is 1.7 m^2 which equals the entire surface area of an adult human body minus head and hands (Te Biesebeek et al., 2014). It is not necessary to correct the value for the parts of the human body that are not covered with textile, because this is already done in the derivation of the skin contact factor (4.3.3). The Q-factor is set to 4 based on the quantitative data in the General Fact Sheet (Te Biesebeek et al., 2014).

Table 6.11: Default values for migration of residues from textile for regular laundry detergents

Default value		Q-factor	Source
General			
Frequency	365 per year	4	Every day
Dermal - direct product contact -migration model			
Exposed area	1.7 m^2	4	See above
Product amount	1 kg	3	Section 4.3.3.
Leachable fraction			
Regular powder	7.6 x 10^{-5} x W_f	1	0.076 g/kg x W_f (See above)
Compact powder	3.8 x 10^{-5} x W_f	1	0.038 g/kg x W_f (See above)
Regular liquid	7.6 x 10^{-5} x W_f	1	0.076 g/kg x W_f (See above)
Compact liquid	4.5 x 10^{-5} x W_f	1	0.045 g/kg x W_f (See above)
Tablet	7.6 x 10^{-5} x W_f	1	0.038 g/kg x W_f (See above)
Capsule	4.5 x 10^{-5} x W_f	1	0.45 g/kg x W_f (See above)

6.2 Hand wash

Scenarios for consumer exposure

Hand washing is performed for clothes that are too delicate for machine washing. Therefore, it is done less frequently than machine washing. The exposure scenario starts with loading the liquid or powder detergent into a bucket. The scenarios for estimating the exposure while loading these powders or liquids are in accordance with the respective generic scenarios (4.1.1 and 4.1.2). After the detergent is added into warm water (40° C), clothes are dipped into the washing water that contains the diluted product. The exposure that the consumer is subjected to during this application phase is in accordance with the generic scenario for application of diluted products (4.2.3). After washing, the consumer wrings the wet clothes and hangs them to dry. It is assumed that the consumer leaves the room while the clothes are drying. Furthermore, it is expected that dermal exposure from wringing the cloths is negligible compared to dermal exposure from that occurs while washing. Any exposure for wringing and drying the clothes is thus not further considered in the exposure scenario. Secondary exposure from wearing the clothes is expected as substances may migrate from the textile to the skin of the consumer. Such secondary exposure is in accordance with the generic scenario for migration from textile (4.3.3.).

- Frequency

Hand washing is mostly performed for clothes too delicate to be washed with the machine and is done less frequent than machine washing. Insight in the Norwegian survey of Laitala et al. (2012) shows that a 75th percentile matches "1-2 cycles per month" for washing delicate laundry that either require a hand wash programme of the washing machine or an actual wash by hand. Insight in the survey of Garcia-Hidalgo et al. (2017) shows that the respondent representing the 75th percentile would choose the multiple choice answer "every week" when asked to the frequency of performing a hand wash. Hence, the surveys of Garcia-Hidalgo et al. (2017) and Laitala et al. (2012) do not match each other. Nonetheless, a new default of 52 times per year is selected based on the data of Garcia-Hidalgo et al., that comprise a higher number of respondents and it is the most conservative choice. The Q-factor is set to 4, because the default is based on quantitatively rich data specifically collected to acquire the frequency of a performing a hand wash.

6.2.1 *Mixing & Loading: Loading hand wash powders*

The exposure estimation for loading powders during hand washing is in accordance with the generic scenario described in section 4.1.1. Hence, inhalation exposure is estimated with the ConsExpo ***inhalation – exposure to spray - instantaneous release model*** and **the *dermal direct product contact – constant rate loading*** model is used to estimate dermal exposure. Defaults for the parameters exposure duration, release duration, product amount (inhalation), room volume, and dermal contact rate are according to the generic scenario for loading powders (4.1.1). Defaults for the parameters product amount (dermal) and ventilation are assumed to be the same as for machine washing (6.1.1).

Table 6.12: Default values for mixing and loading hand wash: powder

Default value		Q-factor	Source
General			
Frequency	52 per year	4	Garcia-Hidalgo et al., 2017
Inhalation -exposure to vapour -instantaneous release			
Exposure duration	0.25 min	3	Section 4.1.1
Product amount	6.2 µg	1	Section 6.1.1
Room volume	1 m^3	1	Section 4.1.1
Ventilation rate	2 per hour	3	Section 6.1.1.
Dermal - direct product contact - constant rate loading			
Contact rate	5 mg/min	3	Section 4.1.1
Release duration	0.25 min	3	Section 4.1.1
Exposed area	225 cm^2	4	Section 4.1.1

6.2.2 *Mixing & Loading: Loading of hand wash liquids*

The exposure estimation for loading liquids for hand washing is in accordance with the generic scenario described in section 4.1.2. Hence, inhalation exposure is estimated with the ConsExpo ***inhalation – exposure to vapour - evaporation*** and ***dermal – direct product contact - instant application loading*** is used to estimate dermal exposure. Defaults for the parameters product amount for inhalation and dermal exposure, room volume, release area, and exposed area are according to the generic scenario for loading liquids (4.1.2). Defaults for the parameters product amount (dermal), ventilation rate, exposure duration and molecular weight matrix are assumed to be the same as for machine washing (6.1.2).

Table 6.13: Default values for mixing and loading hand wash liquid

Default value		Q-factor	Source
General			
Frequency	52 per year	4	Garcia-Hidalgo et al., 2017
Inhalation - exposure to vapour evaporation - constant release			
Exposure duration	0.75 min	3	Section 6.1.2
Product amount	500 g	3	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	2 per hour	1	Bathroom (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Application duration	0.3 min	3	Section 4.1.2
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	90 g/mol	2	Section 6.1.2
Dermal - direct product contact- instant application loading			
Exposed area	225 cm^2	3	Section 6.1.2
Product amount	0.01 g	3	Section 6.1.2

6.2.3 *Application: hand washing of clothes*

During hand washing of clothes, the hands and underarms are submerged under water, whereas volatiles evaporate from the water. The expected dermal and inhalation exposure is estimated in accordance with the generic scenario for application of diluted products (4.2.3). Hence, the ConsExpo ***inhalation – exposure to vapour - evaporation - constant release*** model and the ***dermal – direct product contact - instant application loading*** model are used. Defaults for the parameters release area, product amount for inhalation as well as dermal exposure, weight fraction, and exposed area are according to the generic scenario for application of diluted product (4.2.3).

- Application and exposure duration

The duration of a laundry hand wash is 10 minutes according to AISE (2002). The survey of Garcia-Hidalgo et al. (2017) shows that the respondent representing the 75^{th} percentile would choose the multiple choice answer of "10 minutes" for the task duration of performing a hand wash. After the hand wash, the laundry is left to dry and the consumer will leave the room. Consequently, the exposure duration is set equal to the application duration. The default is set at 10 minutes. The Q-factor is set to 4, because the default is based on quantitatively rich data specifically collected to acquire the duration of a hand wash.

- Product amount -dermal

The product amount that is available for dermal exposure is calculated by multiplying the product concentration in the water in the bucket with the volume of water that is in contact with the exposed skin. The volume of water ending up on the exposed skin upon dipping hands and forearms under water is 22 ml (4.2.3). The concentrations of product in the water in the bucket is used for hand washing are assumed to be equal to the concentration in the water used for machine washing during the first cycle (Table 6.6). The volume of water in the bucket is 15 l (4.2.3) and the volume of water for machine washing per cycle is 17 l (6.1.3). According to AISE (2002; 2009) the weight fraction of hand wash in solution is 0.1-1% which is equal to a concentration of 1-10 g/l. This range is in agreement with the calculated concentrations (Table 6.14). Therefore, these concentrations are used to calculate the default product amounts that are available for dermal exposure.

Table 6.14: Dermal product amounts for laundry hand wash

Detergent	Amount machine wash event (6.1.2) (g)	Concentration in water (g/l)	Dilution Factor (kg product / kg water)	Product amount -dermal (mg)
Regular powder	150	8.8	0.0088	176
Compact powder	75	4.4	0.0044	88
Regular liquid	150	8.8	0.0088	176
Compact liquid	90	5.3	0.0053	106

All are assigned a Q-factor of 3, because they are underpinned with quantitative data with a margin of uncertainty of one order of magnitude.

- Product amount -inhalation

The product amount that is available for inhalation exposure is calculated by multiplying the product concentration (Table 6.14) in the bucket water of with the volume of water that is in the bucket (15 l). Hence, the default product amounts that are available for inhalation using regular powders, compact powders, regular liquids or compacts are calculated to be 132 g, 66 g, 132 g and 80 g respectively. All are assigned a Q-factor of 3, because they are underpinned with quantitative data with a margin of uncertainty of one order of magnitude.

- *Dilution factor*

The dilution factor refers to the ratio of the product amount and the total mass of the substance in which it is diluted (4.2.3). Here, the factor is equal to the product concentration in the water of the bucket expressed kg product per kg water (Table 6.14).The Q-factors are set to 2, because the calculation is not entirely based on expert judgement but lacks underpinning with quantitative data.

Table 6.15: Default values for laundry hand washing

	Default value	Q-factor	Source
General			
Frequency	52 per year	4	Garcia-Hidalgo et al., 2017
Inhalation - exposure to vapour evaporation- constant release			
Exposure duration	10 min	3	Application duration, see above
Product amount			
Regular powder	132 g	3	See above
Regular liquid	66 g	3	See above
Compact powder	132 g	3	See above
Compact liquid	90 g	3	See above
Dilution factor			See above
Regular powder	0.0088	2	See above
Regular liquid	0.0044	2	See above
Compact powder	0.0088	2	See above
Compact liquid	0.0053	2	See above
Room volume	10 m^3	3	Bathroom (Te Biesebeek et al., 2014)
Ventilation rate	2 per hour	4	Bathroom (Te Biesebeek et al., 2014)
Release area	1500 cm^2	3	Section 4.2.3
Application duration	10 min	3	AISE, 2002
Temperature	40^0 C	3	Washing water
Mass transfer coefficient	10 m/h	3	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal - direct product contact- instant application loading			
Exposed area	2200 cm^2	3	Section 4.2.2
Product amount			
Regular powder	0.176 g	3	See above
Regular liquid	0.088 g	3	See above
Compact powder	0.176 g	3	See above
Compact liquid	0.106 g	3	See above

6.2.4 *Application: hanging hand washed clothes to dry*

The estimation for exposure from hanging hand washed textile is calculated to be similar to the exposure estimated for hanging machine washed cloths to dry. The amount of water absorbed by the cloths is expected to be the same (5 l water per 5 kg laundry), and the concentrations of laundry product in the water are also found to be similar (Table 6.13). Consequentially, exposure to laundry products while hanging hand washed laundry is expected to be equal to the exposure from hanging machine washed laundry (Table 6.9).

6.2.5 *Secondary exposure: migration of residues from hand washed textile*

The scenario for secondary exposure from migration of residues of hand washed textile is expected to be similar to the secondary exposure of compact products used for machine washing of (6.1.2). For estimating the secondary exposure the ConsExpo ***dermal - direct product contact - migration*** is used (Delmaar & Schuur, 2016). The defaults for the parameters frequency, and exposed area are also similar to those in the scenario of secondary exposure from machine wash (6.1.4). Furthermore, it is assumed that the 5 l water absorbed by the textile (6.1.3), and the 10% that represents the fraction of the product that is prone to migrate to skin (Corea et al., 2006) are similar for hand and machine wash. The concentration of product in bucket with water (Table 6.14) is a factor of 11.45 larger than the concentration of water in the final cycle of machine wash (Table 6.7). Consequentially, the leachable fractions for hand wash are calculated to be a factor 11.45 larger than those of the leachable fractions derived for machine wash (Table 6.12; Table 6.16).

Table 6.16: Default values for migration of residues from textile for regular laundry detergents

	Default value	Q-factor	Source
General			
Frequency	365 per year	4	Every day
Dermal - direct product contact - migration			
Exposed area	1.7 m^2	4	See above
Product amount	1 kg	3	Section 4.3.3.
Leachable fraction			
Regular powder	$8.7 \times 10^{-4} \times W_f$	1	11.45 X 0.076 g/kg x Wf
Compact powder	$4.3 \times 10^{-4} \times W_f$	1	11.45 X 0.038 g/kg x Wf
Regular liquid	$8.7 \times 10^{-4} \times W_f$	1	11.45 X 0.076 g/kg x Wf
Compact liquid	$5.1 \times 10^{-4} \times W_f$	1	11.45 X 0.045 g/kg x Wf
Tablet	$8.7 \times 10^{-4} \times W_f$	1	11.45 X 0.038 g/kg x Wf
Capsule	$5.1 \times 10^{-4} \times W_f$	1	11.45 X 0.45 g/kg x Wf
Skin contact factor	0.8	1	Section 4.3.3

6.3 Pre-treatment

Besides detergents, there are other laundry products with specific functions; the laundry aids (Smulders & Sung, 2012; www.isditproductveilig.nl). Laundry aids can be categorized in:

- Pre-treatment aids:
    - Laundry or water softeners with mainly builders such as polycarboylates (10-15%) and zeolite (40-60%)
    - Pre-soaking products containing surfactants (10-15%), soap (10-15%) and enzymes (<5%)
    - Pre-wash soil and stain removers with solvents (3-80%), surfactants (0-15%) and enzymes (<5%).
- Boosters containing bleaching agents, e.g. sodium percarbonate (0-80%) or hydrogen peroxide (3-15%) and laundry boosters
- After-treatment aids
    - Fabric conditioners (see chapter 3.3)
    - Starches, e.g. potato, rice, wheat, corn, and stiffeners for synthetic polymers
    - Fabric formers, e.g. stiffener based on a copolymer of polyvinylacetate (10-30%) with an unsaturated organic acid, additives such as polywax
- Laundry dryer aids: sheets impregnated with conditioners

In this chapter only spot removers are discussed. Spot removers are products with high surfactant contents and are applied to soiled areas prior to washing. They are supplied as liquid, granules or in spray application (Smulders & Sung, 2012).

Scenarios for consumer exposure
A consumer applies spot remover on the textile to treat a stain in the bathroom. The spot remover is considered to be a ready-to-use product, so that no exposure from mixing and loading is expected (4.1.3). In case of liquid and spray spot removers, the clothes are assumed not to be wetted before applying. In case of granule spot removers however, the clothes are assumed pre-wetted with water. Next, the textile of the treated spot is rubbed between the palms of the hands to impregnate the dirt with spot remover, leading to direct skin contact with the product. When applying spray spot removers there is also inhalation exposure expected from the spraying itself. During the period of the treated textile left to soak, no exposure is expected because the consumer is assumed to leave the room. Afterwards the treated textile is washed with the other clothes in the washing machine or by hand.

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default for the use of spot removers of 128 times per year, based on a survey of the US-EPA (1989). They give frequency values for laundry boosters (pre-soaks and pre-cleaners), that range from 22 to 300 times per year with a weighted mean of 128 times per year. It is assumed that spot removers are used with a similar frequency as the laundry-boosters. The default is kept at 128 per year. The Q-factor is set to 2, because the original data of US-EPA (1989) are not recent and refer to laundry boosters instead of spot removers.

6.3.1 *Application: spot treatment with granule and liquid spot removers*

To estimate dermal exposure, the ConsExpo ***dermal – direct product contact - instant application loading*** is used.

- Product amount- liquid spot removers

For liquid spot removers, the used product amount for treating textile is 1.3 g (US-EPA, 1989). It is assumed that 50% of the product is absorbed by the treated textile. The remaining 50% is caught between the surface of the textile and the surface of the rubbing hand. The next assumption is that the product is equally distributed over both surfaces. Hence, it is deduced that 25% of the product leads to dermal exposure. Liquid spot removers are used undiluted, so the product amount leading to dermal exposure is 25% of 1.3 g, 0.325 g. The Q-factor is 1, because the default depends strongly on assumptions based on expert judgement only.

Table 6.17: Default values for application of g liquid spot remover

	Default value	Q-factor	Source
General			
Frequency	128 per year	2	US-EPA, 1989
Dermal - direct product contact - instant application loading			
Exposed area	450 cm^2	3	Inside hands (Te Biesebeek et al., 2014)
Product amount	0.325 g	1	See above

- Product amount- granule spot removers

It is assumed that the amount of granules used to treat textile as a spot remover is equal to liquid spot removers. For the use of granules is assumed the textile area with the stain is pre-wetted with water: granules ratio of 1:1 (HERA, 2002). The derived product amount for dermal exposure nonetheless is 0.325 g. The Q-factor is 1, because the default depends strongly on assumptions based on expert judgement only.

Table 6.18: Default values for application of granule spot remover

Default value		Q-factor	Source
General			
Frequency	128 per year	2	US-EPA 1989
Dermal - direct product contact - instant application loading			
Exposed area	450 cm^2	3	Inside hands (Te Biesebeek et al., 2014)
Product amount	0.325 g	1	See above

6.3.2 *Application: spot treatment with spray remover*

Applying spray spot removers consists of two phases: spraying and rubbing (soaking) the treated textile between the palms of the hands. Inhalation exposure is expected from the spraying event. Dermal exposure from spraying is not considered, because it is assumed negligible compared to the dermal exposure resulting from rubbing the product into the textile. The ConsExpo ***inhalation – exposure to spray – spraying release*** model is used to estimate inhalation exposure from spraying and the ***dermal – direct product contact - instant application loading*** model is used to estimate dermal exposure from rubbing. Defaults for the mass generation rate and density non-volatile product are according to the generic scenario for spray application (4.2.1).

- Spray duration

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 0.05 min, which is based on a sprayed product amount of 3.9 g (US-EPA, 1989) and a mass generation rate of 1.6 g/s for trigger sprays (4.2.1). Hence, 2.4 s (0.04 min) is needed to generate the required amount of product. The default value remains 0.05 min with a Q-factor of 3, because it is underpinned with sufficient quantitative data.

- Exposure duration

According to AISE (2014), laundry pre-treatment takes 10 minutes per task. The default for exposure duration is set to 10 minutes. The Q-factor is set to 3, because the original data source specifically refers to laundry pre-treatment but on a qualitative level.

- Product amount -dermal

For spray spot removers the amount used is 3.9 g and the product is used undiluted. It is assumed that 50% of the product is absorbed by the treated textile. The remaining 50% is caught between the surface of the textile and the surface of the rubbing hand. The next assumption is that the product is equally distributed over both surfaces. Hence, it is deduced that 25% of the product leads to dermal exposure. Spray spot removers are used undiluted, so that the product amount leading to dermal exposure is 25%. The default for the product amount is set as 25% of 3.9 g, 1 g. The Q-factor is 1, because the default depends strongly on assumptions based on expert judgement only.

Table 6.19: Default values spraying spot remover

	Default value	Q-factor	Source
General			
Frequency	128 per year	3	US-EPA, 1989
Inhalation - exposure to spray- spraying release			
Spray duration	0.04 min	3	See above
Exposure duration	10 min	3	AISE, 2014
Room volume	10 m^3	4	Bathroom (Te Biesebeek et al., 2014)
Room height	2.5 m	3	Standard height
Ventilation rate	2 per hour	3	Bathroom (Te Biesebeek et al., 2014)
Mass generation rate	1.6 g/s	3	Section 4.2.1
Airborne fraction	0.2	3	Section 4.2.1
Density non-volatile	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution			
Median	100 µm	3	Delmaar & Bremmer, 2009

(c.v.) Inhalation cut-off diameter	(0.37) 15 µm	 3	 Delmaar & Schuur, 2016
Dermal - direct product contact - instant application loading			
Exposed area	450 cm^2	3	Two hand palms (Te Biesebeek et al., 2014)
Product amount	1 g	1	See above

6.3.3 *Secondary exposure: wearing spot treated cloths*

Secondary exposure to spot removers resulting from migration of residues while wearing the treated cloths is estimated with the same approach. Hence, the ***dermal - direct product contact - migration*** is used for spot removers as well. Default parameters for product amount, skin factor and exposed area are set equal to those derived for machine washing (6.1.2).

- Leachable fraction

The leachable fraction is interpreted here as the fraction of a substance in the spot remover that is able to leach from worn cloths to the skin of the person wearing the cloths. The leachable fraction ($FR_{leach(spotremover)}$) is calculated as:

$$FR_{leach(spot\ remover)} = \frac{g_{product(tex)}}{kg_{textile}} FR_{migration} \times W_f$$

The scenario describes that the item treated with the spot remover is washed with the other clothes in the washing machine or by hand. It is assumed that during the washing event the spot remover desorbs from the treated item to the washing water. The amount of spray spot remover in the item is calculated to be 3 g, because upon pre-treatment (6.3.2) it is assumed that 50% of the 3.9 g used ends up sorbed by the textile into the item (2 g) and 25% of the 3.9 used ands up on the surface of the textile (1 g). Calculating the amount of liquid spot remover in the treated item in the same way (50% + 25% x 1.3 g) gives an amount of 0.975 g.
Following the same method for laundry products explained in section 6.1.3 to calculate the residual amounts of spot remover in the textile ($g_{product(tex)}$) that remains in clothing after machine wash gives an amount of 0.076 g. For hand wash the residual amount is calculated to be 1 g, since 3 g is diluted in a bucket of 15 l water and 5 l is sorbed by the clothing (3 g /15 l) x 5 l = 1 g), whereas the residual amounts of liquid spot remover is calculated as 0.25 g for machine wash and 0.325 g for hand wash.
Furthermore, it is assumed that the fraction of spot remover that is able to migrate ($FR_{migration}$) from the textile is set to 10%, as it is assumed to be equal to the one derived for machine washing detergents (6.1.4).
Finally, the default leachable fractions for hand and machine wash for liquid and spray spot removers are derived with the equation above: *(0.0015 g/kg) x W_f* for spray spot remover in machine wash, *(0.0065 g/kg) x W_f* for spray spot remover in hand wash, (5 10^{-4} g/kg x W_f) for liquid spot remover in machine wash and (0.0022 g/kg x W_f) for liquid spot remover in hand wash. The respective Q-factors are set to 2, because the underpinning data is limited.

Table 6.20: Default values for migration of residues from textile for spot removers

Default value		Q-factor	Source
General			
Frequency			
After machine wash	128 per year	3	US-EPA, 1989
After hand wash	52 per year	4	Garcia-Hidalgo et al., 2017
Dermal - direct product contact - migration			
Exposed area	1.7 m^2	4	Section 6.1.4
Product amount	1 kg	3	Section 4.3.3.
Leachable fraction			
Machine wash			
Liquid product	$1.5\ 10^{-6} \times W_f$	2	See above
Spray product	$6.6\ 10^{-6} \times W_f$	2	See above
Hand wash			
Liquid product	$5\ 10^{-7} \times W_f$	2	See above
Spray product	$2.2\ 10^{-6} \times W_f$	2	See above

7 Dish washing products

7.1 Machine dishwashing detergents

Machine dishwashing detergents are used for cleaning dishes by placing them in the dishwasher. The cycling stages of machine dishwashing consist of a pre-wash cycle in which food residues are removed by pure water. This is followed by the wash cycle where the dishwashing detergent is added. After one or two intermittent rinse steps, the final rinse cycle follows in which rinse aid is often added. At the end, the cleaned dishes are dried at high temperature (65° C). At the end of the dishwashing program the dishes should be free of residues, rinse aids and detergents (Prud'homme de Lodder et al., 2006a, Falbe 1987).
A range of liquid, powder and tablet products exists including dishwashing detergents, glass corrosion inhibitors, rinse aids, salts as well as pre-treatment products and products to clean or deodorize the dishwashing machine itself (cleanright.eu). Rinse aids and salts are necessary for pre-softening of hard water. Multifunctional products combine several of these functions, e.g. 3-in-1 or all-in-one products.

Table 7.1: General composition of machine dishwashing detergent (www.isditproductveilig.nl, www.cleanright.eu, Prud'homme de Lodder et al., 2006a, Reward Distribution, 2015, Rahman et al., 2013)

Machine dishwashing detergent	Powder %	Tablet %	All-in-one %	Liquid %
Surfactants				
Non-ionic surfactants	1-5	<5	<5	5-10
Builders				
Alkalis				
-sodium carbonate	45-70	0-40	0-35	3-10
-sodium silicate	5->30	0-15	0-15	
Ion exchangers				
-polycarboxylate		<5	<5	
Complexing agents				
-phosphates		0-45	0-70	
-phosphonates		<5	<5	
Bleaching agents				
Sodium perborate/percarbonate	5-10	15-40	5-15	10-30
TAED	1-2		0-5	
Additives				
Sodium sulphate	1		0-40	20-50
Enzymes	1-3	0-10	0-5	<10
Dye	<1	<1	<1	<10
Perfume	<1	<1	<1	
Water				30-60

Scenarios for consumer exposure
The consumer loads the dishwasher with a powder, liquid or table detergent. Filling the machine with powders may lead to generation of inhalable aerosols which also end up on the backside of the hand holding of the measuring cup. Consequential inhalation and dermal exposure are estimated according to the generic scenario for loading powders (4.1.1.). When using a liquid detergent the consumer removes the cap from the bottle and pours the liquid detergent into the reservoir of the machine. Volatiles may evaporate from the bottle and dermal exposure may occur as splatters end up on the backside of the hand. Inhalation and dermal exposure are estimated according to the generic scenario for loading liquids (4.1.2.). No exposure is expected upon loading the dishwasher with a tablet, because that is considered to be a ready-to-use product (4.1.3). No exposure is expected while the dishwasher is running, because the product is in an enclosed machine during this application phase. Secondary exposure from ingestion of product residues on the dishes is considered negligible in comparison to hand dishwashing (see Prud'homme et al., 2006a; Falbe, 1987). This form of oral exposure is thus not further described for machine dishwashing.

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 252 times per year, based on data of Weegels (Weegels, 1997). AISE (2002) gives a frequency of 3 till 7 times per week with a typical frequency of 5 times. Berkholz et al. (2010) performed a study on consumer dishwashing habits in the UK showing the percentage of owners using the dishwasher at least once a day is 56%. The new default is set at 365 per year with a Q-factor of 3, because it is well underpinned with quantitative data.

7.1.1 *Mixing and loading: loading of dishwash machine powder*

For adding powder to a dishwashing machine, the consumer first pours powder into a measuring cup and then puts the powder into the machine. In accordance with the generic scenario for loading powder, inhalation exposure is estimated with the ConsExpo ***inhalation – exposure to spray - instantaneous release model,*** whereas dermal exposure is estimated with the ConsExpo ***dermal – direct product contact – constant rate loading*** model (4.1.1.). Defaults for the parameters product amount (inhalation), room volume, exposure duration, contact rate, and release duration are taken from the generic scenario (4.1.1).

- Released mass

According to the generic scenario for loading powders (4.1.1) the released mass that becomes available for inhalation is calculated as 8.3 µg per 200 g of the total product amount used. According to AISE (2014) the amount of dishwashing powder varies between 20 to 46 g per task for regular powders and 20 to 40 g per task for compact powders. The new default for released mass of powder dishwash detergent powder is set to 2.5 µg which is based on the highest value for the amount of powder used (46 g per task). The Q-factor is considered to be 1, because of the conservative approach on the amount used and the assumption that the generic scenario is fit for loading dishwashing powders.

Table 7.2: Default values for loading of powder into dishwashing machines

Default value		Q-factor	Source
General			
Frequency	365 per year	3	Scenario
Inhalation -exposure to vapour- instantaneous release			
Exposure duration	0.25 min	3	Section 4.1.1.
Product amount	2.5 µg	1	See above
Room volume	1 m^3	1	Section 4.1.1
Ventilation rate	2.5 per hour	3	Kitchen (Te Biesebeek et al., 2014)
Dermal - direct product contact- constant rate loading			
Constant rate	5 mg/min	3	Section 4.1.1
Release duration	0.25 min	3	Section 4.1.1
Exposed area	225 cm^2	4	Backside hand (Te Biesebeek et al., 2014)

7.1.2 *Mixing and loading: loading of dishwash machine liquid detergents*

A consumer removes the cap from the bottle and pours the liquid detergent into the reservoir of the machine. To estimate exposure the ConsExpo ***inhalation – evaporation – evaporation mode*** and ***dermal – direct product contact - instant application loading*** are used as described in the generic for loading liquids (4.1.2). Defaults for the parameters product amount (inhalation), room volume, application duration, exposure duration and product amount (dermal) are taken from the generic scenario (4.1.2).

- Molecular weight matrix

The fraction of water in liquid machine dishwash detergent ranges between 0.3 and 0.6 (Table 7.1). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.3) which yields 60 g/mol. The Q-factor is 2, because the underpinning quantitative data is limited.

Table 7.3: Default values for machine dishwashing mixing and loading: liquid detergent

Default value		Q-factor	Source
General			
Frequency	365 per year	3	Scenario
Inhalation -Evaporation-constant rate			
Exposure duration	0.75 min	3	Section 4.1.2.
Product amount	500 g	3	Section 4.1.2.
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	2.5 per hour	3	Kitchen (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Application duration	0.3 min	3	Section 4.1.2
Temperature			
Mass transfer	20 °C	4	Room temperature
coefficient	10 m/h	2	Section 4.2.2.
Molecular weight			
matrix	60 g/mol	2	See above
Dermal - direct product contact - instant application loading			
Exposed area	225 cm^2	3	Backside hand (Te Biesebeek et al., 2014)
Product amount	0.01 g	3	Section 4.1.2.

7.2 Machine dishwashing products: rinse aids

Rinse aids reduce the surface tension between the washed dishes and water during the final rinse cycle. Rinse aids allow good clear drying and prevent glass-spots, stains and streaks.

Table 7.4: General composition of machine dishwashing rinse aids (www.isditproductveilig.nl and www.cleanright.eu)

Machine dishwashing rinse aids	liquid %
Surfactants	
Non-ionic surfactants	5-15
Builders	
Citric acid	0-15
Hydrotopes (solubilizes)	5-15
Additives	
Solvents	5-15
Preservatives	<1
Dye	<0.5
Perfume	<1
Water	50-65

Scenarios for consumer exposure

The consumer removes the cap from the bottle and pours the liquid rinse aid into the reservoir of the machine. Volatiles may evaporate from the bottle and dermal exposure may occur as splatters end up on the backside of the hand. Such inhalation and dermal exposure are estimated according to the generic scenario for loading liquids (4.1.2.). No exposure is expected while the dishwasher is running, because the product is in an enclosed machine during this application phase. Oral exposure can occur due to residues left on the washed dishes. According to Weerdesteijn et al. (1999) the residue quantity increases with the detergent concentration and with dishwater temperature. The secondary exposure to rinse aid resulting from ingestion of residues on dinnerware is estimated as described in the respective generic scenario (4.3.4).

- Frequency

Based on information of Weegels (Weegels, 1997) the default value for frequency of filling the machine with polishing liquid is set at 2 times per 3 weeks, i.e. 35 times per year. The Q-factor is set to 3, because the data is specifically collected for filling a dishwash machine with rinse aid. However, the data is not recent and quantitatively rich.

7.2.1 *Mixing and loading: loading of liquid rinse aids*

To estimate exposure the ConsExpo ***inhalation – evaporation – constant rate mode*** **and** ***dermal – direct product contact - instant application loading*** model are used (4.1.2). Defaults for the parameters product amount (inhalation), room volume, application duration, exposure duration and product amount (dermal) are taken from the generic scenario (4.1.2). The default for the parameter exposed area is considered equal to that in the scenario for loading liquid dishwashing detergents into the machine (7.1.2).

- Molecular weight matrix

The fraction of water in the product ranges between 0.5 and 0.65, (see Table 7.4). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.5) which yields 36 g/mol. The Q-factor is 2, because the underpinning quantitative data is limited.

Table 7.5: Default values loading liquid rinse aids in dishwashing machines

	Default value	Q-factor	Source
General			
Frequency	35 per year	3	Weegels, 1997
Inhalation - Evaporation constant rate			
Exposure duration	0.75 min	3	Section 7.1.2
Product amount	500 g	3	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	2.5 per hour	1	Kitchen (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Application duration	0.3 min	3	Section 4.1.2
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	36 g/mol	2	See above
Dermal - direct product contact - instant application loading			
Exposed area	225 cm^2	3	Section 7.1.2
Product amount	0.01 g	3	Section 4.1.2

7.2.2 *Secondary exposure: residues on machine washed dinnerware*

A dishwashing machine cleans the dishes in four cleaning phases through rinsing, cleaning with detergents and hot water, rinsing with cold water, rinsing with hot water, and finally drying. In total, a dishwash machine uses about 14 to 20 l water, so that per cleaning phase the machine uses about 4 l water (Consumenten Bond, 2016). Rinse aids are added at the start of phase 4, the rinsing-with-hot-water phase (Miele, 2016). According to the default factory setting, 30 ml of rinse aid is used. The resulting secondary exposure from the rinse aid that ends up on the cleaned dishes is estimated with the ***oral-direct oral contact- direct oral intake loading***.

- Frequency

The frequency of secondary exposure to rinse aids from oral contact with cleaned is interpreted here as the use frequency of rinse aids: 35 times per year, with a Q-factor of 3 (see above).

- Amount ingested

According to the generic scenario (4.3.4.) the amount of water left on dishes is 5.5×10^{-5} ml/cm^2 and the area of dishes in daily contact with food is 5400 cm^2. The concentration of rinse aid is 7.5 g/l, as the scenario describes a use of 30 ml per 4 l (assuming a liquid density of 1 g/ml). This leads to an ingested product amount of 5.5×10^{-5} ml/cm^2 x 5400 cm^2 x 7.5 mg/ml = 2.25×10^{-3} g. The Q-factor is 1, because it is unclear to what extent the rinse aid is washed off after rinsing with hot water.

Table 7.6: Default values for residues on dishes: machine dishwashing rinse aids

	Default value	Q-factor	Source
General			
Frequency	35 per year	3	Weegels, 1997
Oral-direct oral contact- direct oral intake loading			
Amount ingested	2.25 mg	1	See above

7.3 Hand dishwashing

Food residues on dishes are removed by washing them in water with dishwashing detergent. Mostly, dirt is removed by a brush or scourer for hard-to-remove food residues. The clean items are dried either with a dishcloth or by placing them in a dish drainer to air-dry. The cleaning ability of manual dishwashing products is based on surfactants, solvents, and additives (Table 7.7).

Table 7.7: General composition of liquid hand dishwashing detergent for regular and concentrated products (www.isditproductveilig.nl and cleanright.eu)

Hand dishwashing detergent	regular products %	concentrated products %
Surfactants		
Anionic surfactants	10-20	10-30
Non-ionic surfactants	0-10	0-20
Amphoteric surfactants	0-3	0-5
Solvents		
alcohol	0-3	0-10
Additives		
Preservatives	0-1	0-1
Dye	<0.1	<0.1
Hydrotropes	0-1	0-0.5
Perfume	<0.5	<0.5
Viscosity controlling agents	0-0.5	0-0.5
Water	45-80	45-80

Scenarios for consumer exposure
The consumer removes the cap from a dishwasher bottle and pours detergent directly into a sink with hot water. Inhalation and dermal exposure from loading the liquid dishwashing product into the sink is estimated as described in the respective generic scenario (4.2.1.). When doing the dishes, there is dermal contact of hands and forearms with the diluted dishwashing liquid. Inhalation exposure to volatiles also occurs due to substances that evaporate from the dishwashing water. The exposure from doing the dishes is described in the generic scenario for application of diluted products (4.2.3). Secondary exposure is accounted for by considering ingestion of dishwashing detergent residues on dinnerware. The generic scenario for ingestion of residues from dinnerware (4.3.4) is used to estimate such oral exposure.

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default for hand dishwashing of 426 per year, based on Weegels (1997). AISE (2014) gives a range from 3- 21 times a week, with a typical frequency of 14 times a week. Berkholz et al. (2010) performed a study on consumer dishwashing habits in the UK cleaning a full set of dishes. The frequency of dishwashing by hand was estimated to be at least once per day for 68%-88% of the respondents. Garcia-Hidalgo et al. (2017) present summary data of their survey (n=611) from which it can be derived that over half of the respondents declares to do a dish wash 'more than once a day', which is also the answer of the respondent representing the 75th percentile. The frequency data indicate that the previous default is still within range and considered representative today. Therefore, the default is set at 426 per year. The Q-factor is set to 4, because it is derived from quantitatively rich data sets that are specifically collected for the frequency of performing hand dishwashing.

7.3.1 *Mixing and loading: loading of liquid dishwasher*

The consumer removes the cap from a dishwasher bottle and pours detergent direct into a sink with hot water. The generic scenario for loading liquids is used to estimate the expected inhalation and dermal exposure (4.1.2). Hence, the ***inhalation – exposure to vapour-evaporation – constant rate*** model and the ***dermal – direct product contact - instant application loading*** model are used to estimate inhalation and dermal exposure. Defaults for the parameters product amount (inhalation), room volume, application duration, and product amount (dermal) are taken from the generic scenario (4.1.2). Defaults for the parameters exposure duration and exposed area considered equal as those in the scenario for loading liquid dishwashing detergents into the machine (7.1.2).

- Molecular weight matrix

The fraction of water in product is about 0.5 (Table 7.7). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.5) which yields 36 g/mol. The Q-factor is 2, because the underpinning quantitative data is limited.

Table 7.8: Default values for loading liquid dishwasher detergent into a sink

Default value		Q-factor	Source
General			
Frequency	426 per year	4	Garcia-Hidalgo et al., 2017
Inhalation - exposure to vapour- evaporation constant rate			
Exposure duration	0.75 min	3	Section 7.1.2
Product amount	500 g	3	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	2.5 per hour	1	Kitchen (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Application duration	0.3 min	3	Section 7.1.2
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	36 g/mol	2	See above
Dermal - direct product contact - instant application loading			
Exposed area	225 cm^2	3	Section 7.1.2
Product amount	0.01 g	3	Section 4.1.2

7.3.2 *Application: manual dishwashing*

When doing the dishes, there is dermal contact of hands and forearms with the diluted dishwashing liquid. Inhalation exposure to volatiles occurs due to substances that evaporate from the dishwashing water. The generic scenario for application with diluted products is used to estimate exposure, so that the ConsExpo ***inhalation – exposure to vapour- evaporation – constant rate*** model and the ***dermal – direct product contact - instant application loading*** mode are used (4.2.2). Defaults for the parameters product amount (inhalation), release area, exposed area and product amount (dermal) are taken from the generic scenario (4.2.3).

- Application duration

Weegels (1997) reports a mean duration of dermal contact with dishwashing water of 11 min (st. dev. = 7 min, n=592) and a 75th percentile of 16 min. Andra et al. (2015) presents a median duration for hand dishwashing of 15 min, whereas Kalyvas et al. (2014) presents a 75th of 12 min. Garcia-Hidalgo et al. (2017) present summary data of their survey (n=611) from which it can be derived that the respondent representing the 75th percentile would declare that performing a dishwash task takes between 10 to 30 min. The default of 16 min prescribed in the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) seems to agree with this quantitative data as a realistic but conservative estimate. The Q-factor is set to 4, because it is derived from quantitatively rich data sets that are specifically collected for the duration of performing hand dishwashing.

- Exposure duration

The estimated exposure duration is considered the duration of the dishwashing itself and the tasks after dishwashing, (e.g. emptying the sink or bowl, rinse the kitchen top with water). This duration is estimated by AISE (2014) to range between 10 and 45 minutes with a typical duration of 30 minutes. The default is set at 45 min. The Q-factor is 3, because the default may be over-conservative as it is a maximum of a range based on quantitative data.

- Temperature

Initially the temperature of dishwater is high, approximately 60°C, which will decrease during dishwashing. Ramirez-Martinez et al. (2014) recorded an average water temperature of 36 °C (st. dev. =7.1 °C) which is lower than the 40-45°C reported by Falbe (1987). The default value for water temperature is kept at 45°C representing a more conservative input. The Q-factor is therefore 3, because the default is a maximum of a relatively narrow range.

- Product amount -inhalation

According to AISE (2014) the amount of regular dishwashing liquid used is between 3 and 10 g, whereas the amount of concentrated detergents ranges between 2 and 5 g both per 5 l of water. Ramirez-Martinez (2014) reported an average value of dishwashing liquid of 5.6 g (st. dev. =5.7 g) per 8 l of water for regular dishwasher detergents. The previous Cleaning Product Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a use of 7 g per 5 l water based on the 75th percentile found in a study by Weegels (1997). A concentration of 1.4 g/l reasonably agrees with the data from AISE and Ramirez-Martinez (2014). Weegels derived the 75th percentile for volume of 5 l water in the sink or bowl. In order to be consistent, the product amount in the water is thus calculated as 1.4 g/l x 5 l =7 g. The Q-factor is set to 3, because the concentration data is of high quality but the underpinning data for used volume of water in the sink or bowl is limited.

- Dilution factor

The dilution factor refers to the ratio of the product amount and the total mass of the substance in which it is diluted (4.2.3). Here, the product is diluted by the water in the bowl which is estimated to be 5 l in volume and thus 5 kg in mass, see above. Hence, the dilution factor of 0.0014 is calculated for dishwasher by dividing the product amount of 7g with 5kg of water. The Q-factor is set to 2, because the calculation is not entirely based on expert judgement but lacks underpinning with quantitative data.

- Product amount -dermal

The volume of water ending up on the exposed skin upon dipping hands and forearms under water is 22 ml (4.2.3). The concentration of dishwasher in the water is 1.4 g/l. The product amount that is available for dermal exposure is thus calculated as 1.4 g/l x 22 ml =31 mg. The Q-factor is set to 3, because the concentration data is of high quality but the underpinning data for the volume of water that is in contact with the skin is limited.

Table 7.9: Default values for manual dishwashing

Default value		Q-factor	Source
General			
Frequency	426 per year	4	Garcia-Hidalgo et al., 2017
Inhalation -exposure to vapour evaporation- constant rate			
Exposure duration	45 min	2	AISE, 2014
Product amount	7 g	3	See above
Dilution factor	0.0014	2	See above
Room volume	15 m^3	3	Kitchen (Te Biesebeek et al., 2014)
Ventilation rate	2.5 per hour	4	Kitchen (Te Biesebeek et al., 2014)
Release area	1500 cm^2	3	Section 4.2.3
Application duration	16 min	4	Prud'homme de Lodder et al., 2006a
Temperature	45 °C	3	Temperature water
Mass transfer coefficient	10 m/h	2	Prud'homme de Lodder et al., 2006a Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal - direct product contact - instant application			
Exposed area	2200 cm^2	3	Hands + forearms (Te Biesebeek et al., 2014)
Product amount	31 mg	3	See above

7.3.3 *Secondary exposure: residues on manual washed dinnerware*

It is assumed (as worst case scenario) that all dishes are air-dried, so that residues on the dinnerware are proportional to the concentration of dishwasher detergent in the water. The generic scenario for ingestion of residues from dinnerware is used to estimate the oral exposure. Hence, the ConsExpo ***oral – direct oral contact – direct oral intake*** model is used.

▪ Frequency

It is assumed that clean dishes are used every day for food and drinks, which equals a frequency of 365 times per year. The Q-factor is set to 4, because daily exposure is considered evident in this case.

▪ Amount ingested

According to the generic scenario (4.3.4.) the amount of water left on dishes is 5.5 x 10^{-5} ml/cm^2 and the area of dishes in daily contact with food is 5400 cm^2. The concentration of the dishwashing detergent in water is 1.4 g/l (see above) which leads to an ingested product amount of 5.5x10^{-5} ml/cm^2 x 5400 cm^2 x 1.4 mg/ml = 0.42 mg. The default remains at 0.42 mg. The Q-factor is 2, because the underpinning data is limited.

Table 7.10: Default values for residues on dishes: hand dish wash detergent

	Default value	Q-factor	Source
General			
Frequency	365	4	Everyday
Oral- direct oral contact- direct oral intake model			
Amount ingested	0.42 mg	2	See above

8 All-purpose cleaners

All-purpose cleaners can be used for different cleaning tasks in and around the house such as cleaning floors, windows and mirrors. They are suitable for light cleaning activities. Consumers put high demands on all-purpose cleaners (Falbe, 1997):

- High cleaning performance
- Surface protection
- Residue free drying of clean surface
- Good skin compatibility
- Easy handling/dosage
- Appropriate foaming behaviour
- Pleasant odour during and after cleaning.

All-purpose cleaners are on the market as liquid or in spray form, and can also be available in wipes (wet tissues). All-purpose wipes considered in the current chapter are used for small cleaning jobs.

Table 8.1: General composition of all-purpose cleaners (www.isditproductveilig.nl and www.cleanright.eu)

All-purpose cleaners	Liquid %	Spray %	Wet tissue %
Surfactants		0-15	<10
Anionic	1-10		
Non-ionic	1-10		
Soap	1-5		
Builders		0-5	+???
Sodium carbonate	0-10		
polycarboxylate	0-2		
citric acid / citrate	0-10		
Hydrotropes & solvents	0-15		<10
Solvents	0-10	2-15	
Hydrotropes	0-5		
Additives			
Dye	<0.1	<1	
Fragrances	<1	<1	<1
Preservatives	<0.5	<1	<1
Skin protecting agents	<2		
Water	75-85	85-95	70-95

According to the EPHECT (2012) report, all-purpose cleaners are mostly used in the kitchen (84%) and bathroom (76%) across European countries. The cleaners are less frequently used in the bedroom (31%) and storage rooms (18%). When looking at individual countries (or European zones), different use patterns are visible. Specific information for different EU countries is available from the EPHECT study. Furthermore, the EPHECT study results show that consumers use all-purpose cleaners in order to clean floors (67%), sinks (57%) or toilets (52%). Most consumers use the product in liquid form (80%).

8.1 Liquid cleaners

Scenarios for consumer exposure
Liquid all-purpose cleaners are used for cleaning floors, furniture, toilet, bathroom and kitchen. For manual cleaning of surfaces with a liquid cleaner, a sponge, cloth or mop is used. Generally the cleaner is diluted, but the cleaner can also be used in the undiluted form (i.e. for persistent soil). This scenario describes the cleaning of a living room tile floor (22 m^2) and furniture surfaces, e.g. the tables, cupboards and other flat surfaces (10 m^2). It is thus assumed in this scenario that the consumer cleans 32 m^2 in total. The consumer remains in the living room afterwards for four hours. During mixing and loading, the user pours the cleaning product straight into a bucket (no use of a measuring cup). By doing this, inhalation and dermal exposure to the pure product due to spills- can occur. Next, the consumer cleans the furniture and the floor. For cleaning, the consumer uses either a mop for the floor and a cloth for the furniture. The cloth is dipped into the cleaning water and wrung out. During cleaning, there is intermittent dermal contact with the cleaning dilution throughout the task. After cleaning, the consumer does not wipe the surface dry. Secondary exposure can be expected for children crawling on the treated floor.

- Frequency

In the previous version of the Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) a default for use frequency of 104 times per year is described. According to AISE (2014), surface cleaners are used 1 to 7 times per week with a typical frequency of 2 times per week (104 per year). Weegels (1997) reports a 75th percentile of 320 per year, but that includes cleaning the floor, bathroom etc. According to EPHECT (2012), most people that use all-purpose cleaners do so at least once a week (82%) or even more (36%). Analysis of the EPHECT data (n=1153) results in a 75th percentile use frequency of 0.53 per day (197 per year) (Annex II). Garcia-Hidalgo et al. (2017) present summary data of their survey (n=611) from which it can be derived that the respondent representing the 75th percentile of the consumers that use all-purpose cleaner (n=410) declares to do so for 31-40 min a day. The exposure scenario describes the cleaning task for all-purpose cleaners as cleaning a living room floor and furniture. According to the summary data of Garcia-Hidalgo et al. (2017), the 75th percentile for the duration to clean furniture is '10 to 30 min' and the 75th percentile for the duration to clean a floor is also represented as '10 to 30 min'. The conservative estimate for the duration of performing both tasks is then 60 min. Performing the cleaning task for 197 times per year (Annex II) would yield an exposure frequency of 32 min/day. Moreover, from the summary data of Garcia-Hidalgo et al. (2017) it can be derived that the 75th percentile for the frequency of cleaning floors is 'twice per week', and cleaning furniture 'once per week'. Hence, the scenario of cleaning both the furniture and the floor with all-purpose cleaner for 197 per year (3.8 per week) is consistent with the survey data of Garcia-Hidalgo. The default frequency for the use of all-purpose cleaner is thus set to 197 per year. The Q-factors is set to 4, because it is derived from multiple datasets that are quantitatively rich, complement each other, and are consistent with each other.

8.1.1 *Mixing & Loading: loading liquid all-purpose cleaners*

During opening of the bottle and pouring of liquid all-purpose cleaners into a bucket, volatiles evaporate from the bottle into the personal breathing zone of the consumer. Meanwhile spills (droplets) end up on the backside of the pouring (directing) hand. To estimate exposure the expected exposure the ***inhalation – exposure to vapour - evaporation*** and ***dermal – direct product contact - instant application loading mode*** are used (see section 4.1.2.). Defaults for the parameters product amount (inhalation), exposure duration, room volume, release area, application duration, exposed area and product amount (dermal) are described in the generic scenario (4.1.2).

- Molecular weight fraction

The fraction of water in the liquid cleaning product is estimated at 0.8 (Table 8.1). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.8) which yields 22 g/mol. The Q-factor is 2, because the underpinning quantitative data is limited.

Table 8.2: Default values for all-purpose cleaner liquid: mixing and loading

Default value		Q-factor	Source
General			
Frequency	197 per year	4	Annex II
Inhalation - exposure to vapour -evaporation			
Exposure duration	0.75 min	3	Section 4.1.2
Product amount	500 g	3	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Application duration	0.25 min	3	Section 4.1.2
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	22 g/mol	2	See above
Dermal - direct product contact-instant application loading			
Exposed area	225 cm^2	3	Section 4.1.2.
Product amount	0.01 g	3	Section 4.1.2.

8.1.2 *Application: cleaning with liquid all-purpose cleaners*

During cleaning, the hands and forearms come in contact with the diluted solution when using a cloth or dipping the mop and volatile substances may evaporate from the treated surface during cleaning. To estimate exposure during cleaning the ***inhalation - exposure to vapour - evaporation - increasing release mode*** and the ***dermal – direct product contact - instant application*** loading are used. Please note that default scenario combines the dermal exposure from using a cloth and the inhalation exposure from using a mop in one cleaning task. Defaults for the parameters product amount for dermal exposure and exposed area are described in the generic scenario for application of diluted products (4.2.3.).

- Application duration

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 20 min. According to AISE (2014) the duration of the cleaning task is 10 to 20 minutes. Weegels found an average duration of all-purpose cleaning of 20 minutes (Weegels, 1997). Andra et al. (2015) presents a median of 16 min for mopping floors and Kalyvas et al. (2014) presents a 75th percentile of 15 min for mopping floors. The default value of 20 min thus agrees with difference sources of literature. Therefore, the default value remains at 20 min with a Q-factor of 3.

- Exposure duration

According to the scenario, the exposure duration is 240 min (4 hours). Q-factor is 1, because it is based on expert judgement.

- Product amount -inhalation

The product amount that is available for inhalation is interpreted here as the amount of all-purpose cleaner that is applied on the floor and furniture. According to AISE (2002) the consumer typically uses an amount of 60 g liquid cleaner with a range of 30 to 110 g for the entire cleaning task. Data of EPHECT (2012) show a 75th percentile of 65 g. The data are consistent with the older data sources of Falbe (1987) declaring a use of 25 to 100 g and Weegels (1997) reporting 1 to 63 g. The data of EPHECT is most recent and comprise the most respondents (n=1170). Therefore, the product amount that is available for inhalation is calculated for a product use of 65 g per cleaning task. It is assumed that the 65 g is diluted in a half-empty bucket with 5 l water, so that the concentration is 13 g/l. The product amount that is available for inhalation is calculated by multiplying the volume of water that is applied on the surface with this concentration of all-purpose in the water. In a small experiment it was determined that a wet surface area comprise 40 ml of water per m^2 (Prud'homme de Lodder et al., 2006a). A volume of 1.28 l is thus needed to wet the surface area of 32 m^2 described in the scenario. The default product amount is thus calculated to be 1.28 l X 13 g/l = 17 g. The Q-factors is set to 2, because the underpinning quantitative data is limited.

- Dilution factor

The dilution factor refers to the ratio of the product amount and the total mass of the substance in which it is diluted (4.2.3). Here, the factor is equal to the product concentration in the water of the bucket expressed in kg product per kg water. Hence, the dilution factor is equal to 0.013 The Q-factor is set to 2, because the calculation is not entirely based on expert judgement but lacks underpinning with quantitative data.

- Release area

The release area is interpreted here as the surface area that is being cleaned. According to the scenario, the consumer uses the all-purpose cleaner to clean the floor and furniture. The General Fact Sheet describes a default living room floor of 22 m^2 (Te Biesebeek et al., 2014). By expert judgement it is determined that the consumer also uses the all-purpose cleaner to clean another 10 m^2 of flat surfaces, such as furniture, cupboards and tables. The default release area is thus 32m^2. Q-factor is set 1, because the default strongly depends on expert judgment.

- Product amount -dermal

The product amount that is available for dermal exposure is calculated from the product concentration in the water of the bucket multiplied with the volume of water that is in contact with the consumer's skin. The volume of water ending up on the exposed skin upon dipping hands and forearms under water is 22 ml (4.2.3). The concentration of all-purpose cleaner in the bucket is 13 g/l. The product amount that is available for dermal exposure is thus calculated as 13 g/l x 22 ml = 286 mg. The Q-factor is set to 2, because the underpinning quantitative data is limited.

Table 8.3: Default values for all-purpose liquid cleaners: cleaning

Default value		Q-factor	Source
General			
Frequency	197 per year	4	Annex II
Inhalation - exposure to vapour evaporation- increasing release			
Exposure duration	240 min	1	According to scenario
Product amount	17 g	2	See above
Dilution factor	0.013	2	See above
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	32 m^2	2	See above
Application duration	20 min	3	Weegels, 1997
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal - direct product contact - instant application loading			
Exposed area	2200 cm^2	3	Section 4.1.3.
Product amount	286 mg	2	See above

8.1.3 *Secondary exposure: rubbing off all-purpose cleaners from cleaned surfaces*

Secondary exposure to liquid all-purpose cleaners is only expected for treated surfaces that are accessible to small children. The floor that is treated with the all-purpose cleaner is such an accessible surface for which exposure may occur by rubbing off the product. This form of secondary exposure is estimated with the ConsExpo ***dermal – direct product contact – rubbing off loading*** mode according to the generic scenario for rubbing off (4.3.1). The ***oral-direct product contact - direct oral intake mode*** is used to calculate oral exposure from hand-to-mouth behaviour (4.3.2).

- Contacted surface (S_{area})

The contacted surface (S_{area}) is the area of the treated surface that can potentially be rubbed, which is in this scenario the floor of a living room 22 m^2 (Te Biesebeek et al., 2014). The default is thus set to 22 m^2 and the Q-factor is set to 4, because it is underpinned with quantitatively rich data that is specifically collected to characterize the surface area of a living room floor.

- Dislodgeable amount ($F_{dislodge}$)

As described in the generic scenario (4.3.1), the dislodgeable amount is calculated by multiplying a fraction of 0.3 with the product amount (g) per contact surface area (/m^2). The amount used for cleaning is estimated at 40 ml diluted product per m^2 (density 1 g/ml), so that dislodgeable amount is 12 g/m^2. The Q-factor is set to 2, because the underpinning data is limited.

- Transfer coefficient

The default transfer coefficients value for children is 0.2 m^2/hr for children (4.3.1).

- Contact time (t)

It is assumed that a child of 12 months crawls over a cleaned floor for 1 hour a day. The default is therefore set at 60 min with a Q-factor of 1 as it is derived with expert judgement (Prud'homme de Lodder et al., 2006a).

- Exposed area

The default for exposed skin surface area for children is 0.3 m^2 (4.3.1).

- Ingested Amount

The ingested amount via hand to mouth contact can be calculated by taking 10% of the total external dose (4.3.2).

Table 8.4: Default values for liquid all-purpose cleaners: secondary exposure

Default value		Q-factor	Source
General			
Frequency Body weight	197 per year 9 kg	4 4	EPHECT 2012 4.3.1
Dermal – direct product contact – rubbing off			
Contacted surface Dislodgeable amount Transfer coefficient Contact time Exposed Area	22 m^2 12 g/m^2 0.2 m^2/hr 60 min 0.3 m^2	4 2 3 1 4	Te Biesebeek et al., 2014 See above Section 4.3.1 Prud'homme de Lodder et al., 2006a Section 4.3.1.
Oral-direct product contact -direct oral intake model			
Ingested amount	10% of the total external dose	1	Section 4.3.2.

8.2 Spray cleaners

Scenarios for consumer exposure

The EPHECT study (2014) shows that consumers use all-purpose cleaners to clean sinks (57%) and that most people do this weekly (58%), while a third (29%) use them on a daily basis. About half of the respondents use kitchen spray cleaners (54%). All-purpose cleaners are mostly used in the kitchen (84%). Therefore, the scenario is based on cleaning a kitchen working top. All-purpose cleaning sprays are considered to be ready-to-use products, exposure from mixing and loading is not to be expected (4.1.3.). Consumer exposure to substance in sprays not only depends on the way the product is used, but also on the substance considered. The indoor fate of volatile substances in sprays differs from that of non-volatile substances. Volatile substance are expected to reside in the indoor air after spraying, whereas non-volatile substance occur as spray particles from which a fraction deposits to the surface and a fraction is emitted to the indoor air. In order to assess consumer exposure to non-volatile substances, three phases can be distinguished during cleaning with a spray product. First, the product is sprayed onto the surface with a trigger spray, then it is left to soak (leave-on) for several minutes and finally, the surface is rinsed or wiped with a wet cloth. Exposure during leave-on is however not calculated, because inhalation exposure to non-volatile substances is not expected as they do not evaporate from the surface. Dermal exposure is also not expected during leave-on, because the consumer will not touch the treated surface until it is rinsed or wiped. Upon wiping the surface, dermal exposure is expected from hand contact with the cloth. The treated surface is assumed not to be in reach of small children, so that secondary exposure is also not expected.

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 365 times per year. The exposure scenario describes the task of cleaning a kitchen working top with all-purpose spray. Hence, the use of kitchen spray refers to a similar scenario. Analysis of the data of the EPHECT study (Annex II) shows a 75th percentile for use frequency for kitchen cleaner sprays of 153 per year (n=800) and for all-purpose sprays 190 per year (n=679). AISE (2014) does not report frequencies for the use cleaning sprays. The survey performed by Garcia-Hidalgo et al. (2017) includes the frequency of performing the task of cleaning the kitchen, which fully reflects the exposure scenario described above. By including non-users, it can be derived that the respondent representing the 75th percentile claims to clean the kitchen "twice per week" (104 per year), whereas excluding non-users yields a 75th percentile of "Daily". The default is set to 365 per year based on these data of Garcia-Hidalgo that specifically refers to the exposure scenario of cleaning the kitchen excluding the non-user. The Q-factor is set to 4, because it is derived from a quantitatively rich data source (n=611) specifically collected for the task of cleaning a kitchen described in the scenario of consumer exposure.

8.2.1 *Application: spraying with all-purpose cleaners*

Exposure to non-volatile substances available for inhalation as sprayed particles is estimated with the ***inhalation – exposure to spray – spraying release*** model. The dermal exposure is estimated with the ***dermal – direct product contact - constant rate loading*** model (4.2.1). The defaults for the parameters mass generation rate, airborne fraction, density non-volatiles and contact rate area are in accordance with the generic scenario (4.2.1).

- Spray duration

The spray duration is calculated from the amount of product that needs to be applied to the surface. The kitchen working top has an area of 2 m^2 (Weerdesteijn et al., 1999), whereas 11.1 g of sprayed product is required per m^2 according to the 75th percentile derived in experiments from Weerdesteijn et al. (1999). The sprayed amount is thus 22.2 g. Delmaar & Bremmer (2009) describe a default mass generation rate of 1.6 g/s for all-purpose cleaners, so that the default spray duration here is 14 s (0.23 min). A Q-factor of 3 is given, because of the availability of quantitative but generic data.

- Exposure duration

It is assumed that consumers stay in the kitchen afterwards for at least one hour, the default for exposure duration is set at 60 min. Since this default is based on expert judgement only, the Q-factor is set to 1.

- Mass generation rate

As described above Delmaar & Bremmer (2009) describe a default mass generation rate of 1.6 g/s for all-purpose cleaners based on their own experimental data and that of Tuinman (2004 & 2007). The default mass generation rate is set to 1.6 g/s. The Q-factor is set to 4, because the data is specifically generated for determining the mass generation rate of all-purpose cleaners. Moreover, the data is quantitatively rich given the consistency in the data sets of Delmaar & Bremmer (2009) and Tuinman (2004 & 2007).

- Airborne fraction

Delmaar & Bremmer (2009) experimentally determined an airborne fraction of 0.1 for all-purpose cleaner trigger spray by spraying 10 times with the nozzle pointed towards a back wall 30 cm from the surface. The default airborne fraction is thus set to 0.1. The Q-factor is set to 3, because the data is generated specifically for determining the airborne fraction of all-purpose cleaners, but the number of samples is limited.

- Density non-volatile

Delmaar & Bremmer (2009) estimated the density of the non-volatile compounds in all-purpose to be 1 g/cm^3 based on the elemental composition of the ingredients. The default is thus set to 1 g/cm^3. The Q-factor is 3, because the collected data specifically describe the density of non-volatile compounds in all-purpose cleaner sprays, but the number of samples is limited.

- Initial particle distribution

Delmaar & Bremmer (2009) experimentally derived a mean particle size for bathroom cleaner sprays of 2.4 µm with a coefficient of variation of 0.37. The default initial particle distribution is set accordingly. The Q-factor is set to 3, because the experimental data specifically describe the particle size distribution of all-purpose cleaner sprays, but the number of samples is limited.

Table 8.5: Default values all-purpose spray cleaning: spraying

Default value		Q-factor	Source
General			
Frequency	365 per year	4	Garcia-Hidalgo et al., 2017
Inhalation - exposure to spray-spraying release model			
Spray duration	0.23 min	3	See above
Exposure duration	60 min	1	See above
Room volume	15 m^3	4	Kitchen (Te Biesebeek et al., 2014)
Room height	2.5 m	3	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate	2.5 per hour	3	Kitchen (Te Biesebeek et al., 2014)
Mass generation rate	1.6 g/s	4	Delmaar & Bremmer, 2009
Airborne fraction	0.1	3	Delmaar & Bremmer, 2009
Density non-volatile	1 g/cm^3	3	Delmaar & Bremmer, 2009
Initial particle distribution Median (c.v.)	2.4 µm (0.37)	3	Delmaar & Bremmer, 2009
Inhalation cut-off diameter	15 µm	3	Delmaar & Schuur, 2016
Dermal - direct product contact - constant rate loading			
Contact rate	46 mg/min	3	Section 4.2.1.
Release duration	13 s	3	Equal to spray duration

8.2.2 *Application: removal of all-purpose cleaner sprays from treated surfaces*

The consumer wipes off the treated working top with a wet cloth. Inhalation exposure during this task is already covered with the inhalation estimated from spraying. In this phase only the dermal exposure is relevant from hand contact with the wet cloth. The expected exposure is estimated with the ***dermal – direct product contact – instant application loading*** model (4.2.2.3).

- Product amount -dermal

The spray product is removed with a wet cloth. The surface is thus treated with water. In a small experiment it was observed that the surface is fully wet at 40 ml water per m^2 (Prud'homme de Lodder et al., 2006a). The surface is 2 m^2, so that the amount of water required to wet it is 80 ml. The product amount of 11.1 g applied on the surface (see 8.2.1.) is thus diluted with 80 ml water, so that the concentration of product in the water is 11.g /80ml =0.14 g/ml. The volume of water that ends up on the inside of the hand by touching the wet cloths is calculated by multiplying a layer thickness 0.01 cm (ECHA, 2015a) with the exposed area of 225 cm^2 resulting in 2.25 ml. The product amount that is available for dermal exposure is calculated as 0.14 g/ml x 2.25

ml = 0.31 g. The Q-factor is set to 2, because the data underpinning the calculation is limited.

Table 8.6: Dermal default values spray cleaning: cleaning-phase

	Default value	Q-factor	Source
General			
Frequency	365 per year	4	Garcia-Hidalgo et al., 2017
Dermal - direct product contact- instant application loading			
Exposed area	225 cm^2	3	Inside hand (Te Biesebeek et al., 2014)
Product amount	0.31 g	2	See above

8.3 Wet tissues (wipes)

Scenarios for consumer exposure
Wet tissues or wipes are used for small cleaning jobs on all washable surfaces. They are solid, moist, ready-to-use cleaning products in a package and are suitable for single use after which they are thrown away. Since wet tissues are considered ready-to-use products, exposure from mixing and loading is not expected (4.1.3). The EPHECT study reports that consumers use all-purpose, floor, glass, kitchen and bathroom cleaning wipes. The location of use however is not reported. Therefore the scenario for wet tissues describes the use in a non-specified room (Te Biesebeek et al., 2014). A wet tissue is used to clean a relative small surface, such a table, window or kitchen top. Upon cleaning there is dermal contact with the hand of the consumer. It is not necessary to rinse the surface afterwards. Therefore, exposure from surface removal is not expected (4.2.2.3). Nonetheless, the product is left on the surface to dry out so that inhalation exposure of evaporating substances during this leave-on phase is expected (4.2.2.2). Stronger, the leave-on period already starts at the beginning of the cleaning task, covering the inhalation exposure for the surface application phase as well. It is assumed that the consumer stays in the room for 4 hours after the cleaning task. The treated surface is assumed not to be in reach of small children, so that secondary exposure is not considered.

8.3.1 *Application: cleaning surfaces with all-purpose cleaner tissues*
Consumer exposure from application of wet tissues is considered here for surface application (4.2.2.1.) and leave-on (4.2.2.2). To estimate the expected exposure the ***inhalation – exposure to vapour – evaporation - increasing release*** model and the ***dermal – direct product contact - instant application loading*** model are used. The defaults for the parameters product amount (inhalation), product amount (dermal) and exposed area are in accordance with the generic scenario (4.2.2).

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default frequency of 365 per year. According to AISE (2014) the frequency of use for kitchen wipes is 3.5 times per week. For bathroom wipes the typical frequency is 7 times per week. Analysis of the EPHECT data (Annex II) shows a 75th percentile frequency of 88 per year for all-purpose wipes. Since quantitative data that is specific for all-purpose wipes is available from the analysis of the EPHECT study, the new default is set at 88 per year with a Q-factor of 4.

- Application duration

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default duration of 2 min (Q-factor of 2). According to AISE (2014), wiping surfaces takes typically 5 minutes and ranges between 1 and 10 minutes. Based on this quantitative but generic data, the new default is set at 5 min with a Q-factor of 3.

- Exposure duration

According to the scenario the exposure duration is the duration of the leave-on phase. It is assumed that the consumer stays in the room for at least 4 hours, which is set as default. This default is based on expert judgement only. Therefore, the Q-factor is set to 1.

- Molecular weight matrix

It is assumed here that the molecular weight matrix of the substance in a wet tissue is equal to that of a diluted liquid all-purpose cleaning product. The fraction of water in the liquid fraction of the wipe is 0.8 and thus the molecular weight matrix is 18 g/mol / 0.8 = 22 g/mol (8.1.1). The default remains 22 g/mol. The Q-factor is set to 2, because the underpinning quantitative data is limited.

Table 8.7: Default values all-purpose cleaning: wet tissues

Default value		Q-factor	Source
General			
Frequency	88 per year	4	Annex II
Inhalation - exposure to vapour- evaporation-increasing release			
Exposure duration	240 min	1	Section 8.1
Product amount	11.2 g	4	Section 4.2.2.2
Room volume	20 m^3	4	Non-specified room (Te Biesebeek et al., 2014)
Ventilation rate	0.6 per hour	3	Non-specified room (Te Biesebeek et al., 2014)
Release area	2 m^2	2	According to scenario
Application duration	5 min	3	AISE, 2014
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	22 g/mol	2	See above
Dermal - direct product contact instant application loading			
Exposed area	225 cm^2	3	Section 4.2.2
Product amount	0.05 g	3	Section 4.2.2

9 Abrasives

Abrasives are cleaners with small mineral particles to create a scouring effect that removes dirt firmly attached to a surface. According to AISE (2014) and EPHECT (2012) abrasive powders are still used, but abrasives are nowadays mostly on the market as (creamy) liquids and ready-to-use scouring pads. These scouring pads are a ball of fine steel wire which provides the scouring action, and may contain a cleaning mixture of soap. The use of scouring pads is not described in this Fact Sheet.

Table 9.1: General composition of abrasives (www.isditproductveilig.nl and www.cleanright.eu)

All-purpose cleaners	Powder %	Liquid %
Surfactants		
Anionic	1-5	1-5
Non-ionic		1-5
Soap	0-1	0-1
Abrasives		
Calcium carbonate	90-95	20-50
Sodium carbonate	0-5	1-10
Builders		
Polycarboxylate		0-2
Additives		
Dye	0-0.1	0-0.1
Fragrances	<0.5	0.1-2
Preservatives		<0.5
Water		40-60

9.1 Abrasive powders

When using powders such as abrasive powders, inhalation and oral exposure can occur to particles which whirl around in the air. No special model is available for the use of powders. The exposure to powders can be calculated with the help of the 'spray model', which is developed for the spraying of (liquid) aerosols. The spray cloud model describes the behaviour of a cloud of aerosol particles, but it can also describe a cloud of solid particles, that is in this case a scattered powder.

Scenarios for consumer exposure

Abrasive powder is considered to be a ready-to-use product, since the consumer directly scatters the powder from the packaging to the surface that is to be cleaned. Therefore, there is no exposure considered from mixing and loading (4.1.3). Prud'homme de Lodder et al. (2006a) describes the cleaning of kitchen stoves and working tops. The abrasive powder is scattered for cleaning a kitchen sink and gas stove 0.5 m^2 (approximately 0.16 m^2 kitchen sink and 0.36 m^2 gas stove). Directly after scattering, the consumer suspends the powder with some water and polishes the sink with a wet cloth. Dermal exposure is expected during polishing via hand contact with the wet cloth. It is assumed that the consumer stays in the kitchen afterwards for at least one hour. Secondary exposure is not expected, because the treated surface is cleaned and dried afterwards, moreover it is assumed not to be in reach of small children.

- Frequency

The previous Cleaning Product Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a frequency default of 104 per year, which was based on the 75th percentile derived in a study of Weegels (1997). However, new information has been collected (Table 9.2.). A new default of 91 times per year is set specifically for the use of abrasive powder in the kitchen as described in the consumer exposure scenario. The respective data collected from EPHECT and recalculated in Annex II provide a sufficient number of data points (144) to set the Q-factor to 4.

Table 9.2: Overview of frequencies for the use of abrasive powders according to different references

Frequency (per year)	Quantified as	Cleaned surface	n	Reference
104	Default (2006)	Kitchen	n.a.	Prud'homme de Lodder et al., 2006a
295	75th percentile	Multiple	12	Weegels, 1997
104	Typical	Undefined	n.a.	AISE, 2014
91	75th percentile	Kitchen	144	EPHECT, 2012; Annex II
62	75th percentile	Multiple	142	EPHECT, 2012; Annex II
97	75th percentile	Bathroom	97	EPHECT, 2012; Annex II
55	75th percentile	Floor	67	EPHECT, 2012; Annex II
44	75th percentile	Glass	20	EPHECT, 2012; Annex II

9.1.1 *Application: scattering abrasive powder*

ConsExpo Web does not possess a specific model to simulate exposure from scattering powders (Delmaar & Schuur, 2016). Nonetheless, the ***inhalation - exposure to spray – spraying release*** is parameterized in such a way that it can adapted to assess inhalation exposure to powders as well. For the estimation of dermal exposure the ***dermal – direct product contact - constant rate loading*** is used.

- Spray duration

Spray duration is adapted to the duration of scattering the powder. By expert judgement it is assumed that it takes 1 min to scatter of powder upon a kitchen working top and gas stove. The default is set to 1 min, but with a Q-factor of 1, because it is based on expert judgement.

- Mass generation rate

Mass generation rate (g/s) is adapted here into the amount of product (g) used for the cleaning task divided by the scatter duration (s). The previous Cleaning Product Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 36.9 g per min, which was calculated from the 75th percentile 36.9 g amount scattering powder used per cleaning task in a study of Weegels (1997). The scatter duration is 1 min (see above). Hence, 36.9 g powder per 60 s is being scattered, so that the previous default mass generation rate was set to 0.62 g/s.

However, according to the new information collected from EPHECT and recalculated in Annex II, the 75^{th} percentile of product amount required to clean a kitchen is 35 g. The new default for mass generation rate is therefore set to 0.58 g/s (note that the amount used is the determining factor for the mass generation rate; if a longer or shorter duration of 'spraying' is used, change the mass generation rate accordingly). The Q-factor is 4, because the availability of quantitative data (n=144) specifically collected for the amount used of scattering powders in the kitchen.

- Airborne fraction

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 0.2, which refers to a surface spray with a particle size distribution for which the median diameter is ≥ 50 µm. No new data has become available for abrasive powders, so that the default remains unchanged at 0.2. The Q-factor is set to 1, as the default originally depends on expert judgement only.

- Density non-volatile

The density of salts generally varies between 1.5 and 3.0 g/cm^3. Abrasive powder products consist of 90-95% of calcium carbonates (Table 9.1) which has a density of 2.93 g/cm^3. The default therefore remains 3 g/cm^3 The Q-factor is 4, because the density of calcium carbonate is considered to be evident.

- Initial particle distribution

No information is available on the particle size distributions of scattering powders used to clean kitchens. However, the composition of the powder that consists of fine talc and lime is quite similar or the same to that of crack and crevice powders used as biocides against fleas and ants (ECHA, 2015a). The median particle diameter of crack and crevice powder is characterized as "less than 75 µm". The default particle size distribution for abrasive kitchen powder in the previous Fact Sheet Cleaning Products (Prud'homme de Lodder et al., 2006a) were also derived from particle sizes of comparable biocidal powders (EC, 2002). Since more convincing data have not became available since the previous Cleaning Product Fact Sheet of 2006, the particle size of scatter powder remains characterized as lognormal distribution with a median of 75 µm and a coefficient of variation (c.v.) of 0.6. Given the limited data, the Q-factor is 1.

Table 9.3: Default values for scattering abrasive powders

	Default value	Q-factor	Source
General			
Frequency	91 per year	4	Annex II
Inhalation - exposure to spray- spraying release			
Spray duration	1 min	2	See above
Exposure duration	60 min	3	Scenario
Room volume	15 m^3	4	Kitchen (Te Biesebeek et al., 2014)
Room height	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate	2.5 per hour	3	Kitchen (Te Biesebeek et al., 2014)
Mass generation rate	0.58 g/s	4	See above

Airborne fraction Density non-volatile Initial particle distribution Median (c.v.) Inhalation cut-off diameter	0.2 3 g/cm³ 75 µm (0.6) 15 µm	1 4 1 3	Prud'homme de Lodder et al., 2006a Calcium carbonate Prud'homme de Lodder et al., 2006a Delmaar & Schuur, 2016
Dermal - direct product contact- constant rate loading			
Contact rate Release duration	5 mg/min 1 min	1 2	Section 4.1.1. "Spray duration"

9.1.2 *Application: polishing surfaces with abrasive powders*

The expected dermal exposure from polishing a wetted surface with abrasive powders and a wet cloth is estimated as described in the generic scenario for surface treatment (4.2.2). Hence, the ***dermal – direct product contact - instant application loading*** is used.

- Product amount

In Annex II it is presented that for cleaning a kitchen with scattering powders an amount 35 g is used. The abrasive powder is removed with a wet cloth. The surface is thus treated with water. In a small experiment it was observed that the surface is fully wet at 40 ml water per m^2 (Prud'homme de Lodder et al., 2006a). The surface is 2 m^2, so that the amount of water required to wet it is 80 ml. A product amount of 35 g is applied on the surface, so that the concentration of product in the water is 35 g /80 ml =0.44 g/ml. The volume of water that ends up on the inside of the hand by touching the wet cloths is calculated by multiplying a layer thickness 0.01 cm (ECHA, 2015a) with the exposed area of 225 cm^2: 2.25 ml. The product amount that is available for dermal exposure is calculated as 0.44 g/ml x 2.25 ml = 0.98 g. The default for the dermal product amount is therefore 0.98 g. The Q-factor is set to 2, because the underpinning quantitative data is limited.

Table 9.4: Default values for abrasive powders cleaning with cloth

	Default value	Q-factor	Source
General			
Frequency	91 per year	4	Annex II
Dermal -direct product contact- instant application loading			
Exposed area Product amount	225 cm² 1 g	3 2	Inside hand (Te Biesebeek et al., 2014) See above

9.2 Abrasive liquids

Abrasive liquids are suspensions of solid abrasive particles in a viscous creamy liquid matrix. The mineral composition of abrasive liquids mainly consists of calcium carbonates. Furthermore, the ingredients of abrasive liquids are quite comparable to that of abrasive powders added with water (Table 9.1). There are also liquids especially for cleaning ceramic cooking rings on the market, which contain surfactants and metal oxides as abrasives, such as aluminium oxide.

Scenarios for consumer exposure
Abrasive liquid is considered to be a ready-to-use product, since the consumer directly applies the liquid unto the surface that is to be cleaned by squeezing the bottle. Therefore, there is no exposure considered from mixing and loading (4.1.3.). The surface to be cleaned is a kitchen sink and gas stove of 0.5 m^2 (approximately 0.16 m^2 kitchen sink and 0.36 m^2 gas stove). Directly after application, the consumer starts to polish the sink and stove with a wet cloth. Dermal exposure is expected during polishing via hand contact with the wet cloth. Inhalation exposure is anticipated as well, since volatile substance may evaporate from the treated surface. It is assumed that the consumer stays in the kitchen afterwards for at least one hour. Secondary exposure is not expected, because the treated surface is cleaned and dried afterwards, moreover it is assumed not to be in reach of small children.

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 156 per year. According to AISE (2014) respondents clean once or twice per week, with a typical use frequency of surface cleaners of 2 times per week (between 1 and 7 times per week). Weegels reports a 75^{th} percentile frequency for the use of abrasives (powder and liquids) of 295 per year (Weegels et al., 1997). Analysis of the EPHECT survey data (2012) shows 75^{th} percentile use frequency of cleaning creams for kitchen of 135 per year, for all-purpose of 84 per year, for bathroom of 88 per year, for floor of 55 per year and for glass of 62 per year. Based on the scenario, the more recent data and number of data points (n=144), the new default is set at 135 per year. The Q-factor is 4, because the data sources are quantitatively rich and specifically collected abrasive liquids used to clean the kitchen.

9.2.1 *Application: polishing surfaces with abrasive liquids*

The expected exposure from polishing a kitchen top and stove with abrasive liquids is estimated as described in the generic scenario for surface treatment (4.2.2). Therefore, inhalation exposure is estimated with the *inhalation – exposure to vapour - evaporation - increasing release mode,* whereas for dermal exposure the *dermal – direct product contact - instant application loading* is used.

- Application duration

According to AISE (2014) the task duration of surface cleaning is 10-20 minutes. The new default value for cleaning the working top and gas stove with abrasives liquid is set at 20 min with a Q-factor of 3.

- Product amount -inhalation

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 37 g. AISE (2002) gives a range of 30-110 g (typical 60 g) for liquid surface cleaners. Weegels (1997) reports a 75^{th} percentile of 36.9 g abrasive per event. Analysis of EPHECT (2012) survey data shows 75^{th} and 95^{th} percentile use amounts of cleaning creams kitchen of 32 and 76 g, respectively (Annex II). A new default is set specifically for the use of abrasive liquid in the kitchen as described in the consumer exposure scenario. The respective data collected from EPHECT and recalculated in Annex II provide a sufficient number of data points (144) to set the Q-factor to 4. The new default value is thus set at 32 g with a Q-factor of 4.

- Molecular weight matrix

According to the composition of abrasive liquids (Table 9.1) the water fraction is 0.4. Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.4) which yields 45 g/mol. The Q-factor is 2, because the underpinning quantitative data is limited. The molecular weight matrix is calculated as 18 g/mol / 0.4 = 45 g/mol. The default is set at 45 g/mol with a Q-factor of 2.

- Product amount -dermal

The abrasive liquid is removed with a wet cloth. The surface is thus treated with water. In a small experiment it was observed that the surface is fully wet at 40 ml water per m^2 (Prud'homme de Lodder et al., 2006a). The surface is $2 m^2$, so that the amount of water required to wet it is 80 ml. The product amount applied on the surface is thus diluted with 80 ml water. The concentration in the water can then be calculated as 32 g / 80 ml = 0.4 g/ml. The volume of water that ends up on the inside of the hand by touching the wet cloths is calculated by multiplying a layer thickness of 0.01 cm (ECHA, 2015a) with the exposed area of 225 cm^2: 2.25 ml. The product amount that is available for dermal exposure is calculated as 0.4 g/ml x 2.25 ml = 0.9 g. The new default is set to 0.9 g. The Q-factor is set to 2, because the data underpinning the calculation is limited.

Table 9.5: Default values for cleaning with abrasive liquids

	Default value	Q-factor	Source
General			
Frequency	135 per year	4	Annex II
Inhalation - exposure to vapour- evaporation- increasing release			
Exposure duration	60 min	3	Scenario
Product amount	32 g	4	Annex II
Room volume	15 m^3	4	Kitchen (Te Biesebeek et al., 2014)
Ventilation rate	2.5 per hour	3	Kitchen (Te Biesebeek et al., 2014)
Release area	2 m^2	3	See above
Application duration	20 min	3	See above
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	45 g/mol	2	See above
Dermal - direct product contact- instant application loading			
Exposed area	225 cm^2	3	Inside hand (Te Biesebeek et al., 2014)
Product amount	0.9 g	2	See above

10 Sanitary products

Different sanitary products are available on the market for specific cleaning purposes, such as the removal of normal organic and inorganic soils as well as lime scale and rust deposits from water. Generally, sanitary products are liquid acidic products that can be used undiluted. Bathroom cleaners are usually liquids available in bottles, spray bottles and as aerosol foams. This chapter describes the use of liquid bathroom cleaning products, spray bathroom cleaners, toilet cleaners and toilet rim cleaners.

10.1 Bathroom cleaners

Bathroom cleaners are products specially designed for cleaning different surfaces in bathrooms, such as bathtubs, sinks, faucets, and shower cabins. Bathroom cleaners are used by a large fraction of the European population according to EPHECT (2012) as 77% of their respondents declare to use them. Furthermore, the EPHECT survey shows that bathroom cleaners are used, as intended, mainly in bathrooms (96%) and toilets (64%), where they are used for cleaning toilets (80%), showers (73%), bathtubs (71%), sinks (61%), walls (29%), floors (28%) and mirrors (21%). Most respondents prefer to use bathroom cleaners in liquid form (67%). Spray products are the second most popular form (51%).

Table 10.1: General composition of bathroom cleaners

All-purpose cleaners	Liquid %	Liquid strong[A] %	Spray[B] %
Surfactants			1-5
Anionic	1-5	0-5	
Non-ionic	1-5	1-5	
Cationic		5-15	
Builders			0-10
Polycarboxylate, NTA or trisodium methylglycine diacetate	0-2	5-30	
Acids			
Citric acid	1-5		0-5
Sulfonic, lactic, formic acid			
Solvents			
Isopropanol	0-15		0-5
Additives			
Thickening agents	<1	<1	<1
Preservatives	<0.5	<1	<1
Dye	<0.02	<1	<1
Fragrances	<1	<1	<1
Water	50-90	65-95	70-95

[A] composition adopted from Prud'homme de Lodder et al. (2006a)
[B] non-foam sprays, based on information of NVZ 2014

10.1.1 *Liquid bathroom cleaners*

Scenario for consumer exposure
During mixing and loading, the user pours the bathroom cleaner straight into a bucket (no use of a measuring cup). By doing this, inhalation exposure from evaporation and dermal exposure to the pure product due to spills can occur. Next, the consumer cleans a shower cubicle with 4 walls of $2m^2$ as surface to treat. While cleaning the contaminated surface, the user is exposed dermally to the dilution from dipping the cloth into the bucket. Inhalation exposure to volatile substances is expected from evaporation of the substance from the treated surface. It is assumed that the consumer will leave the bathroom 5 minutes after the cleaning task. Secondary exposure is not anticipated, since the treated surfaces will not be in reach of small children.

- Frequency

According to AISE (2014), the use frequency of liquid surface cleaners is 1-7 per week. According to EPHECT (2012), most consumers use bathroom cleaners weekly (71%) or at least once a week (80%). The 75^{th} percentile of the use frequency of bathroom cleaner is according to EPHECT 'several times a week' (EPHECT, 2012; *Table Q 53*). Analysis of the EPHECT survey data shows a probabilistically simulated 75^{th} percentile for the use frequency of 2.7 per week (Annex II). Garcia-Hidalgo et al. (2017) present summary data from which it can be derived that '3-6 times per week' represents the 75^{th} percentile for the frequency of cleaning the bathroom excluding the respondents that claim to never clean the bathroom. The summary data presented by Garcia-Hidalgo et al. (2017) proves to be internally consistent as their 75^{th} percentile for the use frequency of liquid bathroom cleaner expressed in min/day (11-20 min/day) divided by their 75^{th} percentile for duration of the cleaning task (10 -30 min) yields a range of 2.6 - 14 times per week. The 75^{th} percentile of 3-6 times per week falls within this range. A default frequency of 3 times per week, 156 per year, agrees with the use frequency of liquid bathroom cleaner according to EPHECT (EPHECT, 2012; Annex II) and Garcia-Hidalgo (2017) as well as for the frequency of the task of cleaning the bathroom (Garcia-Hidalgo et al., 2017). Given the consistency across different sets with quantitatively rich data specifically collected for the use of bathroom cleaner, the Q-Factor of the default frequency is set to 4.

10.1.1.1 Mixing & Loading: loading liquid bathroom cleaners

During opening of the bottle and pouring of liquid bathroom cleaners into a bucket, volatiles evaporate from the bottle into the personal breathing zone of the consumer. Meanwhile spills (droplets) end up on the backside of the pouring (directing) hand. To estimate the expected exposure the ***inhalation – exposure to vapour - evaporation - constant rate*** and ***dermal – direct product contact - instant application loading*** are used (see section 4.1.2.). Defaults for the parameters product amount (inhalation), exposure duration, room volume, release area, application duration, exposed area and product amount (dermal) are described in the generic scenario (4.1.2).

- Molecular weight matrix

According to their general composition the fraction of water in liquid bathroom cleaners is 0.5 (Table 10.1). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.5) which yields 36 g/mol. The Q-factor is 2, because the underpinning data is limited.

Table 10.2: Default values mixing and loading: bathroom cleaning liquid

	Default value	Q-factor	Source
General			
Frequency	156 per year	4	EPHECT, 2012; Garcia-Hidalgo et al., 2017
Inhalation - exposure to vapour evaporation -constant release model			
Exposure duration	0.75 min	3	Section 4.1.2.
Product amount	500 g	3	Section 4.1.2.
Room volume	1 m^3	1	Section 4.1.2.
Ventilation rate	2 per hour	3	Section 4.1.2.
Release area	20 cm^2	2	Section 4.1.2.
Application duration	0.3 min	3	Section 4.1.2.
Temperature	20 °C	3	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	36 g/mol	2	See above
Dermal - direct product contact - instant application loading			
Exposed area	225 cm^2	3	Section 4.1.2.
Product amount	0.01 g	3	Section 4.1.2.

10.1.1.2 Application: cleaning with liquid bathroom cleaner

During cleaning, the hands and forearms come in contact with the dilution and volatile substances evaporate from the treated surface during cleaning. To estimate exposure during cleaning the ***inhalation - exposure to vapour - evaporation - increasing release*** and **the *dermal – direct product contact - instant application loading*** are used. Defaults for the parameters product amount for dermal exposure and exposed area are described in the generic scenario for application of diluted products (4.2.3.).

- Product amount -inhalation

The product amount that is available for inhalation is interpreted here as the amount of liquid bathroom cleaner on the surface of the shower cubicle. Analysis of the EPHECT (2012) study shows a 75th percentile of 67 g for the amount used of liquid bathroom cleaner for the entire cleaning task (Annex II). It is assumed that the 67 g is diluted in a half-empty bucket with 5 l water, so that the concentration in the bucket is 13.4 g/l. Based on a small experiment it is determined that 40 ml water wets 1m^2 of surface (Prud'homme de Lodder et al., 2006a). The shower cubicle is 8m^2, so that 320 ml of water is required to clean it. Evaporation from the surface of water in the bucket is an additional emission source of substances into the indoor air of the bathroom that is however marginal compared to the emission from the cleaned surfaces. The amount of liquid bathroom cleaner that is on the surface is calculated to be 4.3 g by multiplying the volume on the shower cubicle surface (320 ml) with the concentration of product in the water (13.4 g/l). The Q-factor is set to 2, because the assumed 5 l in the half-empty bucket and the 40 ml per m^2 of water on the surfaces compromises the quality of the EPHECT data.

- Dilution factor

The dilution factor refers to the ratio of the product amount and the total mass of the substance in which it is diluted (4.2.3). Here, the factor is equal to the product concentration in the water of the bucket expressed in kg product per kg water. Hence, the dilution factor is equal to 0.0134. The Q-factor is set to 2, because the calculation is not entirely based on expert judgement but lacks underpinning with quantitative data.

- Application duration

According to the survey of AISE, the duration of the cleaning the bathroom is 10 to 20 minutes (AISE, 2014). Andra et al. (2015) present a median duration of 15 min, whereas Kalyvas et al. (2014) present a 75^{th} percentile of 19 min for consumers cleaning the shower. Garcia-Hidalgo et al. (2017) present summary data from which it can be derived that the 75^{th} percentile is between 10 and 30 min. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 20 min, which reasonably agrees with these different data sources. The default value therefore remains 20 minutes. The Q-factor is set to 4, because the data is quantitatively rich and specifically collected for cleaning the shower.

- Exposure duration

The user is expected to remain in the bathroom after cleaning for 5 minutes. Therefore, the default remains 25 min. The Q-factor is 4, because the high quality data referring to the application duration is compromised by the assumption that the consumer stays in the room for 5 min after the cleaning task.

- Product amount -dermal

The product amount that is available for dermal exposure is calculated from the product concentration in the water of the bucket multiplied with the volume of water that is in contact with the consumer's skin. The volume of water ending up on the exposed skin upon dipping hands and forearms under water is 22 ml (4.2.3). The concentration of bathroom cleaner in the bucket is 13.4 g/l. The product amount that is available for dermal exposure is thus calculated as 13.4 g/l x 22 ml = 295 mg. The Q-factor is set to 2, because the underpinning quantitative data is limited.

Table 10.3: Default values for bathroom liquid cleaners: cleaning

	Default value	Q-factor	Source
General			
Frequency	156 per year	4	EPHECT, 2012; Garcia-Hidalgo et al., 2017
Inhalation -exposure to vapour- evaporation - increasing release			
Exposure duration	25 min	3	See above
Product amount	4.3 g	2	See above
Dilution factor	0.0134	2	See above
Room volume	10 m^3	4	Bathroom (Te Biesebeek et al., 2014)
Ventilation rate	2 per hour	3	Bathroom (Te Biesebeek et al., 2014)
Release area	8 m^2	3	Scenario
Application duration	20 min	4	AISE, 2014
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is mainly water
Dermal - direct product contact- instant application loading			
Exposed area	2200 cm^2	3	Section 4.2.3.
Product amount	295 mg	3	See above

Note: In the scenario description above, the expected use of bathroom liquids being diluted is assessed. Some consumers however directly use the undiluted liquid, by means of taking a drenched cloth and the formulation and then clean the tiles or shower cabins. For this situation, it is advised to calculate the dermal exposure with the dermal – direct product contact - instant application loading assuming a contact area of one hand. For inhalation exposure, the exposure to vapour- evaporation- increasing release mode can be used. The latter model needs adjustment for duration and amounts by the assessor (case by case).

10.1.2 *Spray bathroom cleaners*

Scenario for consumer exposure

The consumer treats a shower cubicle with 4 walls of 2 m^2 with a trigger spray. Spray bathroom cleaners are ready-to-use products, mixing and loading is thus not required before application of the product. Upon application, the product is first sprayed onto the surface. At this moment inhalation exposure is expected from aerosols generated by the trigger spray, whereas dermal exposure is also expected from sprayed aerosols depositing to the unprotected skin of the consumer. Once the cleaning product is sprayed onto the surface of the walls it is left to soak (leave-on) for several minutes. Finally, the surface is rinsed or wiped with a wet cloth. Exposure during leave-on is however not calculated, because inhalation exposure to volatile substances in sprays is already covered by exposure during spray application (4.2.2.). Dermal exposure is also not expected during leave-on, because the consumer will not touch the treated surface until it is rinsed or wiped. Upon wiping the surface, dermal exposure is expected from hand contact with the cloth. Such dermal exposure is considered equal to that of cleaning the bathroom with liquid cleaner. The treated surface is assumed not to be in reach of small children and the consumer will leave the shower cubicle after the cleaning task, so that secondary exposure is not expected.

- Frequency

Analysis of EPHECT (2012) gives a 75th percentile of the use frequency of 120 per year (n=740) of bathroom spraying products (Annex II), whereas Westat (1987) gives a 75th percentile of 52 times per year. A 75th percentile of '1-10 min/day' is derived from the summary data (n=611) of Garcia-Hidalgo et al. (2017). The task duration of cleaning the bathroom with spray cleaner is set to 10 min based on the data of AISE (2009, see below). Assuming that the task takes 10 min, the use frequency derived from the summary data of Garcia-Hidalgo et al. (2017) of 1-10 min per day can be recalculated into a frequency of 37 - 365 per year. Nonetheless, it is not certain to what extent this frequency is due the duration of the task or the frequency of performing the task. Therefore the EPHECT data (Annex II) is more appropriate for derivation of the default frequency. Still, the summary data of Garcia-Hidalgo (2017) at least indicates that their frequency expressed in min/day is consistent with the frequency expressed as per day by EPHECT (2012). The 75th percentile derived from Westat (1987) is considerably smaller. The data of EPHECT (2012) and Garcia-Hidalgo et al. (2017) however is preferred over that of Westat (1987), because they are more recent and are consistent with each other. The default frequency is thus set to 120 per year. The Q-factor is set to 4, because the default is derived from quantitatively rich and consistent datasets specifically collected for the use of bathroom spray cleaner.

10.1.2.1 Application: spraying with bathroom cleaner

Inhalation exposure to sprayed aerosols is estimated with the ***inhalation – exposure to spray – spraying release***. The dermal exposure is estimated with the ***dermal – direct product contact - constant rate loading*** model. The defaults for the parameters mass generation rate, density non-volatiles and contact rate area are in accordance with the generic scenario (4.2.1).

- Spray duration

According to Weerdesteijn et al. (1999) the 75th percentile for the amount required to clean surfaces is 11.1 g per m^2. The shower cubicle has a surface area of 8 m^2, resulting in a sprayed amount of 88.8 g. Delmaar & Bremmer (2009) found a bathroom trigger spray to generate 1.25 g/s, so that the spray duration is calculated as 88.2 divided by 1.25 is 71 s. The new default value is set at 1.2 min. The Q-factor is set to 3, because the underpinning data specifically refers to spraying bathroom cleaner but the number of samples is limited.

- Exposure duration

The exposure duration is interpreted here as the sum of the duration of the cleaning task itself and the time spent in the bathroom afterwards. According to AISE's the cleaning task duration is maximal 10 min (AISE, 2014), whereas Kalyvas et al. (2014) presents a 75th percentile of 19 min for consumers cleaning the shower. The data of AISE is based on 5249 respondents in 23 different European countries, whereas Kalyvas collected data from 224 respondents from Nicosia, Cyprus. From the survey data of Garcia-Hidalgo et al. (2017) it is derived that the respondent representing the 75th percentile would declare that it takes 10-30 min to clean the bathroom, which agrees with the 19 min derived by Kalyvas et al. (2014). The scenario describes that the consumer remains in the bathroom for 5 min after the task is finished. Therefore, the new default is set at 24 min. The Q-factor is set to 3, because the duration of cleaning task is represented with high quality data (quantitatively rich and specifically collected for cleaning the bathroom) that is however compromised by the assumption that the consumer stays for 5 min in the bathroom afterwards.

- Airborne fraction

Since the spray is meant for cleaning surfaces only a small part becomes airborne. Hence, the generic default airborne fraction 0.2 based on the experiments of Delmaar & Bremmer (2009) is used as the default for bathroom sprays. The Q-factor is 2, because the experiments of Delmaar & Bremmer only comprise a limited number of samples and the data generically refer to surface sprays instead of specifically referring to bathroom sprays.

- Initial particle distribution

Delmaar & Bremmer experimentally derived a mean particle size for bathroom cleaner sprays of 3.6 μm with a coefficient of variation of 0.52. The default initial particle distribution is set accordingly. The Q-factor is set to 3, because the experimental data specifically describe the particle size distribution of bathroom sprays, but the number of samples is limited.

Table 10.4: Default values for bathroom cleaning: spraying phase

	Default value	Q-factor	Source
General			
Frequency	120 per year	4	EPHECT, 2012; Garcia-Hidalgo et al., 2017
Inhalation - exposure to spray- spraying release model			
Spray duration	1.2 min	3	See above
Exposure duration	24 min	3	See above
Room volume	10 m^3	4	Bathroom (Te Biesebeek et al., 2041)
Room height	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate	2 per hour	3	Bathroom (Te Biesebeek et al., 2014)
Mass generation rate	1.25 g/s	3	Delmaar & Bremmer, 2009.
Airborne fraction	0.2	2	Delmaar & Bremmer, 2009
Density non-volatile	1.8 g/cm^3	3	Section 4.2.1.
Initial particle distribution Median (c.v.)	3.6 μm (0.52)	3	Delmaar & Bremmer, 2009
Inhalation cut-off diameter	15 μm	3	Delmaar & Schuur, 2016
Dermal - direct product contact -constant rate loading			
Contact rate	46 mg/min	3	Section 4.2.1.
Release duration	1.2 min	3	"Spray duration"

10.1.2.2 Application: cleaning with bathroom cleaner spray

Dermal exposure to bathroom spray during the cleaning task is expected, as the consumer touches a wet cloth that contains the sprayed product. According to the generic exposure scenario for cleaning with a wet cloth (4.2.2), the dermal exposure is estimated with the ***dermal - direct product contact - instant application loading***.

- Product amount

The product amount is calculated from the concentration of bathroom spray product in the water that is absorbed by the wet cloth. This concentration is equal to the amount of product sprayed onto the shower cubicle divided by the volume of water applied to the shower surface. According to the scenario, the consumer cleans a shower cubicle with a surface of 8 m^2. In a small experiment it was determined that 40 ml of water wets 1 m^2 of surface, so that it is derived that the volume of water on the shower surface is 320 ml. The amount of sprayed product is 88.8 g (see 'spray duration' in section 10.1.2.1). The concentration in of product in the cleaning water is thus 88.8g / 320 ml = 0.2775 g/ml. The consumer is in dermal contact with 2.25 ml water by touching the wet cloth (4.2.2), so that the product amount that is available for dermal exposure is 2.25 ml x 0.2775 g/ml = 0.62 g. The default product amount is thus set to 0.62 g. The Q-factor is set to 2, because the underpinning data is limited.

Table 10.5: Default values for cleaning with bathroom spray

	Default value	Q-factor	Source
General			
Frequency	156 per year	4	EPHECT, 2012; Garcia-Hidalgo et al., 2017
Dermal - direct product contact - instant application loading			
Exposed area	225 cm^2	3	Section 4.2.2.
Product amount	0.62 g	2	See above

10.2 Toilet pan cleaners

Toilet cleaners are divided in two different products: toilet pan cleaners containing acids for removing calcium or metal salts and toilet pan cleaners containing a bleaching system which can be hydrogen peroxide or hypochlorite. In this section both types of toilet pan cleaners are described for their use in the lavatory pan.

Table 10.6: General composition of toilet pan cleaners

Toilet cleaners	Liquid, acid[1,2] %	Liquid, bleaching[1,3)] %
Surfactants		
Anionic surfactants	0 – 10	0 – 10
Non-ionic surfactants	1 – 15	2 – 10
Cationic surfactants	0 – 15	
Acids	0 – 10	
Sulfonic, citric, lactic, formic phosphoric and sulfamic acid		

Salts, acids, bases		2 – 10
Bleaching agents[4] Active hydrogen peroxide Active hypochlorite		1 – 5
Additives Polymers Builders Dye Perfume	 0 – 5 < 1 < 1	 0 – 5 0 – 2 < 1 < 1
Water	85 – 90	85 – 90

1. Vollebregt et al., 1994.
2. Vollebregt & Van Broekhuizen, 1994.
3. Unilever Nederland, 2006
4. Bleaching products with active oxygen could be acid or alkaline, whereas products containing hypochlorite are always alkaline.

Scenarios for consumer exposure
The consumer cleans the interior of the toilet pan. Toilet pan cleaners are considered to be ready-to-use products, so that exposure from mixing and loading is not anticipated (4.1.3). Rather, the product is directly applied with a squeeze bottle under the rim of the toilet pan. Then the toilet cleaner is left to soak (leave-on) for several minutes. After this leave-on period, the toilet pan is brushed. While brushing, dermal contact with the toilet pan cleaner may occur. The consumer may also inhale volatile substances that evaporate from the cleaning product. The consumer washes the hands after the cleaning and flushes the toilet. Secondary exposure after flushing the toilet is not considered, because it will be negligible compared to the exposure during the cleaning task. Hence, exposure is only expected from the cleaning task itself. The ***inhalation - exposure to vapour evaporation- constant release*** is used to estimate inhalation exposure during the task of cleaning the toilet, whereas the ***dermal - direct product contact - constant rate loading*** is used to estimate the dermal exposure.

- Frequency

The previous Cleaning Product Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 260 per year based on Weegels (1997). These authors investigated the use of toilet cleaners and derived a mean frequency of 2 times per week (st. dev. =4.2, n=10) and a 75th percentile of 5 times per week (Weegels, 1997). According to the AISE survey (2014), the maximum use frequency is 2 times a week. According to the summary data of Garcia-Hidalgo et al. (2017) the respondent representing the 75th percentile would declare to clean the toilet '3-6 times per week' which would take '1-10 min per task' or '1-10 min per day'. Hence, the summary data presented by Garcia-Hidalgo et al. (2017) proves to be internally consistent. A default frequency is set to 156 per year (3 times a week) as it seems to agree with the different data sources. The Q-factor is set to 4, because the data is quantitatively rich and specifically collected for the task of cleaning the toilet.

- Application duration

According to AISE (2014) it takes "less than 1 min" to clean the toilet pan. Weegels (1997) found a mean value of 72 s (st. dev. of 41 s) and a

75^{th} percentile of 100 s (total range 10 to 150 s). According to the summary data of Garcia-Hidalgo et al. (2017), the 75^{th} percentile for application duration would be '1-10 min per task' or '1-10 min per day' for a frequency of '3-6 times per week'. The default value remains 2 min, because this duration agrees with the data of Weegels and of Garcia-Hidalgo et al. (2017) for task duration (1-10 min per task) and frequencies (1-10 min a day; 3-6 times a week). The Q-factor is set to 4, because the data of Weegels and Garcia-Hidalgo et al. (2017) are consistent, quantitatively rich, and specifically collected for the duration of cleaning a toilet bowl.

- Exposure duration

The previous Cleaning Product Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 3 min. Recent studies of Andra et al. (2015) and Kalyvas et al. (2014) however, show that 3 min is an underestimation of the exposure duration. Rather, the questionnaire data of Andra et al., shows a median duration for the entire cleaning task of 8 min (n=57), whereas the questionnaire data of Kalyvas et al., present a 75^{th} percentile of 7 min (n=224). A new default is set at 7 min, based on the data of Kalyvas et al. (2014) that comprises the largest number of investigated individuals. Q-factor is 4, because the underpinning data is quantitatively rich and specifically collected for the task of cleaning a toilet.

- Room volume

The previous Cleaning Product Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 2.5 m^3.This is a worst case approach as it is assumed that the door is closed. The default remains 2.5 m^3, but the Q-factor is lowered to 2 as the underlying data and assumptions are based on a combination of expert judgment and data on toilet volumes from the General Fact Sheet.

- Release area

The release area is equal to the surface that needs to be cleaned, which is the inside of the toilet pan. This surface is calculated as that of the cloak of a truncated cone plus the bottom of the toilet pan. The radius of the upside of a standard toilet is about 20 cm and the radius of the bottom about 5 cm. The depth of the toilet is about 20 cm and the rim about 5 cm. The toilet rim is not considered to be part of the lavatory pan, so that the depth of the surface to treat is 20-5=15 cm. The cloak of the truncated cone is calculated as:

$$S_{toilet} = \pi(r_{upside} + r_{bottom})\sqrt{(r_{upside} - r_{bottom})^2 + depth_{pan}{}^2} + \pi r_{bottom}{}^2$$

$$S_{toilet} = \pi(20 + 5)\sqrt{(20 - 5)^2 + 15^2} + \pi 5^2 \approx 1750cm^2$$

The default release area is thus set at 1750 cm^2. The Q-factor is 2, because the data underpinning the calculation is limited.

- Product amount -inhalation

The lavatory pan of the toilet is cleaned with an undiluted cleaning product. Furthermore, the product amount depends on whether the type of toilet pan cleaner is based on acid or bleach. According to Weegels

(1997), the average amount bleach agents used is 55 g and the 75th percentile is 80 g, (st. dev. =37 g, n=9). For acid agents Weegels found an average amount of 40 g and 75th percentile of 55 g (st. dev. =22g, n=12). AISE only gives 30 g as typical amount for liquid toilet cleaners, whereas for gel toilet cleaners the typical amount is set as 25 g with a range from 20 to 35 g (AISE, 2014). Therefore, the default product amounts for inhalation are still based on Weegels 75th percentiles, 80 g for bleach and 55 g for acids. The Q-factor is 3, because the number of data points is limited (n=9 for bleach, n=12 for acids) but it is specifically collected for the cleaning of toilet pans.

- Contact rate

The consumer is dermally exposed through splatters of undiluted product from roughly brushing the toilet pan. It is assumed that the dermal exposure can be estimated with the same approach as the rough brushing application of biocides (ECHA, 2015a) that describe a 75th percentile contact rate of 193 mg/min. The default is thus set to 191 mg/min. The Q-factor is set to 2, because the original data (HSL, 2001) is quantitatively rich, but actually refers to painting rough wooden joints. Hence, the quality of the data is compromised by assuming it is suitable for estimation dermal exposure from brushing a toilet.

Table 10.7: Default values for cleaning a toilet

	Default value	Q-factor	Source
General			
Frequency	156 per year	4	Weegels, 1997; Garcia-Hidalgo et al., 2017
Inhalation - exposure to vapour evaporation- constant release			
Exposure duration	7 min	3	Kalyvas et al., 2014
Product amount		3	Weegels, 1997
Acid toilet pan cleaner	55 g		
Bleach toilet pan cleaner	80 g	3	Weegels, 1997
Room volume	2.5 m^3	2	Toilet room (Te Biesebeek et al., 2014)
Ventilation rate	2 per hour	3	Toilet room (Te Biesebeek et al., 2014)
Release area	0.175 m^2	2	See above
Application duration	2 min	4	Weegels, 1997
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Dermal - direct product contact - constant rate loading			
Exposure area	2200 cm^2	3	Hands and forearms (Te Biesebeek et al., 2014)
Contact rate	193 mg/min	2	ECHA, 2015a
Release duration	2 min	4	Application duration

10.3 Toilet rim blocks

Toilet rim blocks are placed upon the inner ring of the toilet pan. They release active ingredients into the pan at each flush of the toilet, so that the toilet pan is cleaned automatically and a nice fresh smell is released. There are two main types of rim blocks: solid and liquid rim blocks.

Table 10.8: General composition of toilet rim cleaners (NVZ 2004)

Toilet rim cleaners	Liquid %	Solid %
Surfactants Anionic surfactants Non-ionic surfactants	 10 – 30 2 - 10	 30 – 50 1 - 10
Filler Sodium sulphate		40 – 60
Additives		
Perfume	5-10	3 - 10
Water	rest	

Scenario for consumer exposure
The toilet rim block is considered to be a ready-to-use product, so that there is no exposure expected from mixing and loading (4.1.3). Toilet rim blocks are designed to constantly provide a fresh smell in the room. Hence, it is assumed that the amount of product that is in the air is constant over time. The consumer will experience inhalation exposure to this steady air concentration during toilet visits. The ***inhalation – exposure to vapour – evaporation - instant release*** is used to calculate the expected inhalation exposure from the steady state air concentration.

- Product amount

The product amount that is available for inhalation is interpreted as the amount of product that is in the air. The air concentration is constant over time, which means there is a steady state situation. For such a steady state situation the amount of product in the air can be calculated from a mass balance equation (Mackay, 2001): $m = E/k$. Here is m the amount of product in the air, E is the emission of the product to the air and k is the removal rate by means of ventilation. Ventilation in a toilet room is 2 per hour (Te Biesebeek et al., 2014). The emission is calculated as the mass of the rim block divided by service life time of the product. In the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) the mass of a solid rim block is by default 30 g and its service life 30 days, whereas a liquid rim block contains 70 g of substance and has a service life of 60 days. Hence, the steady state amount of product in the air is 0.021 g for solid blocks and 0.024 g for liquid blocks. The Q-factor remains 2, because the underpinning data is limited.

- Ventilation rate

For this specific calculation the ventilation rate is set to zero to avoid double calculation of the amount of substance removed. Ventilation is the process that removes the product from the air in the toilet room. However, this removal process is already included in the calculation of the steady state product amount.

- Exposure duration

The exposure duration is here the duration of a toilet visit of the consumer. It is assumed that the consumer goes to the toilet 10 times a day for 5 min, so that the daily exposure duration is by default 50 min.

The Q-factor for this default is 1, because it depends on expert judgement only.

Table 10.9: Inhalation default for toilet rim cleaner

	Default value	Q-factor	Source
General			
Frequency	365 per year	4	Everyday
Inhalation - exposure to vapour-instant release			
Exposure duration	50 min	1	See above
Product amount			
Solid rim blocks	0.21 g	2	See above
Liquid rim blocks	0.24 g	2	See above
Room volume	2.5 m^3	4	Toilet room (Te Biesebeek et al., 2014)
Ventilation rate	0 per hour	2	See above

11 Floor, carpet and furniture products

Floor, carpet and furniture care products combine cleaning and polishing aspects. Depending on their function the product contains either more cleaning or more protecting compounds. Default values are given for floor cleaners and polishers (Section 11.1), carpet cleaners (Section 11.2) and furniture and leather products (Section 11.3).
Consumers can also choose from additional cleaning products to suit their specific floor surface, e.g. stone, parquet, laminate and wood. These products will not be covered in detail, but the scenarios described in this chapter can be used to estimate the exposure to these products.

11.1 Floor products

Floor products can be divided in floor cleaners, floor polishes, combined products, seal products and strip products. For floor seal and strip products only general information is given (see Section 11.1.)
Combined floor cleaners remove dirt and grease and, once dried, provide a lasting shine to floors and a thin layer of wax to offer protection to new stains (www.cleanright.eu; EPHECT, 2012).

Table 11.1: General composition of floor cleaning and protecting products

Floor products	Cleaner liquid[A] %	Polisher[A] %	Combined product[A,B] %	Sealer[A] %	Strip-per A[A,C] %	Strip-per B[C] %
Surfactants		0-5				
Anionic	5-15		1-10		0-15	
Soap	1-30		1-5		0-5	
Non-ionic	5-15		1-10		0-5	
Builders	<5				3-8	
NTA, phosphates,			0-2			
Phosphonates			0-0.5			
Citric acid			1-10			
Alkalis					3-10	
Sodium (bi)carbonate			0-10			
Solvents	0-15					
Alcohols			5-25			
Glycols/glycolethers		0-5	1-5	0-5	0-15	0-20
2-butoxyethanol						10-50
Nonoxynol					3-15	2-5
Monoethanolamine						10-30
Hydrotropes					0-5	
Cumeensulphonate			0-0.5			
Waxes		1-5	1-10	0-5		
Resins and polyacrylates		10-25	1-10	10-80		
Plasticizers		1-10	0-5	0-5		
Additives						
Preservatives	<1	<1	<0.5	<1	<1	

Colorants			0-0.1			
Fragrances	<1	<1	<1	<1	<1	
Water	>50	80	50-70	70-85	60-80	

[A] composition adopted from Prud'homme de Lodder et al. (2006a)
[B] www.cleanright.eu
[C] Household Cleaning Products Parameters 2015

Among those who use floor cleaners, almost two-thirds (60%) use the product on a weekly basis (once or more a week), and nearly a quarter (23%) on a monthly basis. Very few respondents use floor cleaners daily (8%) (EPHECT, 2012). With respect to the most used application types, 91% of the consumers prefer using floor cleaners in liquid form, while fewer prefer other forms such as spray (15%), or wipes. Analysis of the EPHECT study resulted in 75th percentiles of use frequencies of liquid (161 per year), wipes (66 per year), spray (73 per year), tablets (30 per year), foam (74 per year), gel (73 per year), cream (47 per year) and powder (47 per year). Floor cleaners are used on floors in the kitchen (83%), the bathroom (75%), the living room (67%) or hallway (62%).

11.1.1 *Floor cleaning liquids*

Scenarios for consumer exposure
The cleaning task is to clean the floor of a living room with an area of 22 m^2. First, the consumer opens the bottle containing floor cleaning liquid and pours it into a bucket filled with 5 l water. Upon opening of the bottle and the pouring of the liquid agent into the bucket, volatiles evaporate from the bottle into the personal breathing zone of the consumer, whereas dermal exposure is anticipated from loading the liquid through spilled droplets that end up on the backside of the hand. Then the diluted product is applied to the floor surface with a mop. During application dermal exposure to the hands and forearms is anticipated from dipping the mop into the bucket containing the diluted product. Inhalation exposure is anticipated at this moment as well, since volatile substances evaporate from the treated surface. Afterwards, the consumer leaves the treated surface to dry to the air and remains in the living room for four hours. Furthermore, secondary exposure can be expected for children crawling on the treated floor.

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 104 per year. According to AISE (2014) surface cleaners are used 1 to 7 times per week with a typical frequency of 2 times per week (104 per year). The 75th percentile of 320 per year as reported by Weegels (1997) also includes cleaning the floor, bathroom, and other cleaning tasks. Analysis of the EPHECT study (2012) resulted in a 75th percentile use frequency for liquid of 161 per year (Annex II). From the summary data of Garcia-Hidalgo et al. (2017) it is derived that the respondent representing the 75th percentile would declare to clean the floor 'twice per week', whereas the 75th percentile for the duration of cleaning the floor is estimated to be 11 -30 min. The frequency in min/day for this task however is not included in their data. Consequentially, it is not possible to verify whether task duration and frequency are consistently collected. Therefore, the EPHECT study is chosen here as data source for deriving a new default, because the data is recent, rich (n=1333) and specifically collected for the task of cleaning floors. The new default is thus set at 161 per year with a Q-factor of 4.

11.1.1.1 Mixing & Loading: loading of floor cleaning liquids
The expected exposure from loading floor cleaning liquid into a bucket is similar to that described in the generic scenario for loading liquids (4.1.2). Hence, to estimate exposure during this mixing and loading event the ***inhalation – exposure to vapour - evaporation - constant release*** and the ***dermal – direct product contact - instant application loading*** are used. Defaults for the parameters product amount (inhalation), exposure duration, application duration, room volume, ventilation rate, release area, product amount (dermal) and exposed area are described in the generic scenario (4.1.2).

- Molecular weight matrix

The fraction of water in the undiluted liquid cleaning product is estimated at 0.5 (Table 11.1). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.5) which yields 36 g/mol. The Q-factor is 2, because the underpinning quantitative data is limited.

Table 11.2: Default values mixing and loading: floor cleaner liquid

	Default value	Q-factor	Source
General			
Frequency	161 per year	4	Annex II
Inhalation - exposure to vapour- evaporation-constant release			
Exposure duration	0.75 min	3	Section 4.1.2
Product amount	500 g	3	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	0.5 per hour	1	Section 4.1.2
Release area	20 cm^2	2	Section 4.1.2
Application duration	0.3 min	3	Section 4.1.2
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	36 g/mol	2	See above
Dermal - direct product contact - instant application loading			
Exposed area	225 cm^2	3	Section 4.1.2
Product amount	0.01 g	3	Section 4.1.2

11.1.1.2 Application: cleaning the floor with liquid
The scenario of cleaning a floor agrees with the generic scenario for surface treatment (4.2.2.). Hence, to estimate the expected exposure the ***inhalation – exposure to vapour - evaporation - increasing release*** and ***dermal – direct product contact - instant application loading*** are used. Default parameter values for exposed area and product amount (dermal) are described in the generic scenario for application of diluted product (4.2.3.).

- Application duration

Application duration is interpreted here as the duration of the cleaning task. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 30 min. According to AISE (2014) the cleaning task takes 10 to 20 min. Weegels (1997) found an average duration of all-purpose cleaning of 20 min. Andra et al. (2015) presents a median of 16 min for mopping floor, whereas Kalyvas et al. (2014) presents a 75th percentile of 15 min. A new default value is set at 20 min, because this duration seems to agree with the different data sources. The Q-factor is 4, because the data is recent, quantitative and specifically collected for the task of cleaning floors.

- Exposure duration

By expert judgement the exposure duration is set to 240 min. As such, the Q-factor is 1.

- Product amount -inhalation

The product amount that is available for inhalation is calculated as the floor cleaning liquid that is applied to the floor. The floor cleaning liquid is diluted in water. Based on a small experiment, it is assumed that 40 ml of suds is applied per m^2. According to the scenario the surface to treat is 22 m^2 so that 880 ml of water is applied to the floor. The concentration of the floor cleaning liquid in the water applied to the floor is calculated from the product amount loaded into the bucket and the volume of water in the bucket (5 l). According to the survey of AISE, the amount of floor cleaning liquid can range between 30 and 110 g (AISE 2014). Analysis of the EPHECT data (2012) shows a 75^{th} percentile of 82 g. The EPHECT study is chosen here as data source for deriving a new default, because the data are recent, rich (n=1333) and specifically collected for the task of cleaning floors. The concentration of product in the water is thus calculated to be 16.4 g/l. The amount of product that is applied to the floor is then 16.4 g/l x 880 ml = 14.4 g. The default for product amount available for inhalation is rounded to 15 g. The Q-factor is set to 2, because the EPHECT data is of high quality but compromised by the assumed volume of water in the bucket and the volume of water applied to the floor.

- Dilution factor

The dilution factor refers to the ratio of the product amount and the total mass of the substance in which it is diluted (4.2.3). Here, the factor is equal to the product concentration in the water of the bucket expressed in kg product per kg water. Hence, the dilution factor is equal to 0.0164. The Q-factor is set to 2, because the calculation is not entirely based on expert judgement but lacks underpinning with quantitative data.

- Product amount -dermal

The product amount that is available for dermal exposure is calculated from the volume of water that is in contact with the skin and the concentration of the floor cleaning product in the water. According to the generic scenario for application of diluted products, the volume of water left on the skin after dipping hands and forearms under water is 22 ml (4.2.3). The concentration in the water is calculated as 16.4 g/l (see above). Hence, the product amount available for dermal exposure is 16.4 g/l x 22 ml= 0.36 g.

Table 11.3: Default values for cleaning the floor with liquids

	Default value	Q-factor	Source
General			
Frequency	161 per year	4	Annex II
Inhalation - exposure to vapour- evaporation- increasing release			
Exposure duration	240 min	1	Scenario
Product amount	15 g	2	See above
Dilution factor	0.0164	2	See above
Room volume	58 m^3	3	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	22 m^2	4	Scenario
Application duration	20 min	4	AISE, 2014; Andra et al., 2015; Kalyvas et al., 2014; Weegels, 1997
Temperature	20 °C	2	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal - direct product contact - instant application loading			
Exposed area	2200 cm^2	3	Section 4.2.3
Product amount	0.36 g	2	See above

11.1.1.3 Secondary exposure: rubbing off floor liquid cleaners from cleaned surfaces

Secondary exposure to liquid floor cleaners is expected, since the treated floor is accessible to small children. This form of secondary exposure is estimated with the ConsExpo ***dermal – direct product contact – rubbing off*** according to the generic scenario for rubbing off (4.3.1). The ***oral-direct product contact -direct oral intake*** is used to calculate oral exposure from hand-to-mouth behaviour (4.3.2).

- Contacted surface (S_{area})

The contacted surface (S_{area}) is the area of the treated surface that can potentially be rubbed, which is in this scenario the floor of a living room 22 m2 (Te Biesebeek et al., 2014). The default is thus set to 22 m^2 and the Q-factor is set to 4, because it is underpinned with quantitatively rich data that is specifically collected to characterize the surface area of a living room floor.

- Dislodgeable amount ($F_{dislodge}$)

As described in the generic scenario (4.3.1), the dislodgeable amount is calculated by multiplying a fraction of 0.3 with the used product amount per surface area (g/m^2), which is in this scenario equal to 0.2 g/m^2 (0.3 x 14.4 g /22 m^2 , see 11.1.1.). The Q-factor is set to 2, because the underpinning data is limited.

- Contact time (t)

It is assumed that a child of 12 months crawls over a cleaned floor for 1 hour a day. The default is therefore set at 60 min with a Q-factor of 1 as it is derived with expert judgement (Prud'homme de Lodder et al., 2006a).

- Ingested Amount

The ingested amount via hand to mouth contact can be calculated by taking 10% of the total external dose (4.3.2).

Table 11.4: Default values for liquid all-purpose cleaners: secondary exposure

	Default value	Q-factor	Source
General			
Frequency	161 per year	4	Annex II
Body weight	9 kg	4	4.3.1
Dermal – direct product contact – rubbing off loading model			
Contacted surface	22 m^2	3	Scenario
Dislodgeable amount	0.2 g	2	See above
Transfer coefficient	0.2 m^2/hr	3	Section 4.3.1
Contact time	60 min	2	Prud'homme de Lodder et al., 2006a
Exposed Area	0.3 m^2	4	Section 4.3.1.
Oral-direct product contact -direct oral intake model			
Ingested amount	10% of the total external dose	1	Section 4.3.2.

11.1.2 *Floor strip and seal products*

Floor strip and seal products are no traditional cleaning product by the definition of products developed to remove dirt and sanitizing surfaces. However, their application is comparable to traditional cleaning products and they are developed to keep in-house surfaces clean. Floor sealers are applied before using a new floor. They seal floors such as linoleum, to prevent dirt, water and grease to get into the pores of the floor easily. This effect can be strengthened by adding a floor polish that comprises a polymeric or wax layer. Old protective layers can be removed with floor-strippers, which are often strong alkalines. The alkaline concentration depends on the age of the layer and on the difficulty of removing the layer. Floor strip and seal products are discussed below as one group of product, because of their complementary actions in preventing the floor to get contaminated with dirt and their commonalities in way they are applied to treat the floor.

Scenarios for consumer exposure

The consumer first applies the strip product to the floor of a living room room with an area of 22 m^2. Floor strip products require dilution with water before they are applied. First, the consumer opens the bottle containing the liquid floor strip product and pours it into a bucket filled with 5 l water. Note, the volume of a bucket is considered to be 15 l (4.2.3), but for this specific scenario it assumed that the bucket is not entirely full. Upon opening of the bottle and the pouring of the liquid agent into the bucket, volatiles evaporate from the bottle into the personal breathing zone of the consumer, whereas dermal exposure is anticipated from loading the liquid through spills (droplets) that end up on the backside of the hand. The diluted product is then applied to the floor surface with a mop. During this application dermal exposure to the hands and forearms is anticipated from dipping the mop into the bucket containing the diluted product. Inhalation exposure is anticipated at this moment as well, since volatile substances evaporate from the treated surface. Afterwards, the consumer leaves the treated surface to dry to the air before treating it with the floor sealer. The floor sealer is a ready-to-use product that is used undiluted. Exposure from mixing and loading is thus not to be considered. Instead, the floor sealer is directly applied to the floor with a squeeze bottle and spread over the floor with a mop. Dermal exposure may occur at this moment if the consumer accidentally touches the treated surface. Inhalation exposure to volatile substances evaporating from the treated surface is anticipated as well. It is assumed the consumer leaves the room directly after the task is finished.

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default by expert judgement of once per 10 year for floor strippers and once a year for sealers. No new data have become available ever since. However, floor strip and seal products are assumed here to be used complementary. Following a worst case approach, the default frequency is therefore 1 per year for both products. The Q-factor remains 1, because it depends on expert judgement only.

11.1.2.1 Mixing and loading: loading liquid floor strip products

Loading liquid floor strip products into a bucket agrees with the generic scenario for loading liquids (4.1.2). Hence, to estimate exposure during this mixing and loading event the ***inhalation – exposure to vapour - evaporation - constant release*** and the ***dermal – direct product contact - instant application loading*** are used. Defaults for the parameters product amount (inhalation), exposure duration, application duration, room volume, release area, product amount (dermal) and exposed area are described in the generic scenario (4.1.2).

- Molecular weight matrix

The fraction of water in the floor strip product is estimated at 0.6 (Table 11.1). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.6) which yields 30 g/mol. The Q-factor is 2, because the underpinning quantitative data is limited.

Table 11.5: Default values for mixing and loading of floor strip products

	Default value	Q-factor	Source
General			
Frequency *Floor strip products*	1 per year	1	Prud'homme de Lodder et al., 2006a
Inhalation - exposure to vapour- evaporation- constant release			
Exposure duration	0.75 min	3	Section 4.1.2.
Product amount	500 g	3	Section 4.1.2.
Room volume	1 m^3	1	Section 4.1.2.
Ventilation rate	0.5 per hour	1	Living room (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2.
Application duration	0.25 min	3	Section 4.1.2.
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2.
Molecular weight matrix	30 g/mol	2	See above
Dermal -direct product contact- instant application loading			
Exposed area	225 cm^2	3	Section 4.1.2.
Product amount	0.01 g	3	Section 4.1.2.

11.1.2.2 Application: treating the floor with strip products

The scenario of treating a floor with strip products agrees with the generic scenario for surface treatment (4.2.2.). Hence, to estimate the expected exposure the ***inhalation – exposure to vapour - evaporation - increasing release*** and ***dermal – direct product contact - instant application loading*** are used. Default parameter values for exposed area and product amount (dermal) are described in the generic scenario for application of diluted product (4.2.3.)

- Application duration

Application duration is interpreted here as the time required to apply the floor strip product to the floor. It is assumed that such an activity is similar to applying liquid polish products to the floor. The default application duration is thus 90 min (Section 11.1.3). The Q-factor is 2, because the underpinning data are not recent and not collected specifically for treating the floor with strip products.

- Product amount -inhalation

The product amount that is available for inhalation is interpreted as the amount of floor strip product that is applied on the floor. Product label information advises a dilution 100-200 g per 10 l water (Pallmann, 2016). From a worst case perspective, it is assumed that the consumer uses 200g per 10 l (20 g/l). The volume of water that can be applied on the floor is estimated to be 880 ml (see Section 11.1.1). The product amount that is applied to the floor can thus be calculated as 20 g/l x 880 ml = 17.6 g. The default product amount available for inhalation is thus set at 18 g. The Q-factor is 2, because the underpinning data is limited.

- Product amount -dermal

The product amount that is available for dermal exposure is calculated from the volume of water that is in contact with the skin and the concentration of the floor strip product in the water. According to the generic scenario for application of diluted products, the volume of water left on the skin after dipping hands and forearms under water is 22 ml (4.2.3). The concentration in the water is calculated as 20 g/l (see above). Hence, the default product amount available for dermal exposure is 20 g/l x 22 ml= 0.44 g. The Q-factor is 2, because of the limited data on product use that is incorporated in this calculation.

Table 11.6: Default values for treating the floor with floor strip products

	Default value	Q-factor	Source
General			
Frequency	1 per year	1	Prud'homme de Lodder et al., 2006a
Inhalation - exposure to vapour evaporation increasing release			
Exposure duration	90 min	1	Application duration
Product amount	18 g	2	See above
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	22 m^2	2	Scenario
Application duration	90 min	3	Section 11.1.3.
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water after dilution
Dermal - direct product contact- instant application loading			
Exposed area	2200 cm^2	3	Section 4.2.3.
Product amount	0.44 g	2	See above

11.1.2.3 Application: treating the floor with seal products

The scenario of inhalation exposure from treating a floor with seal products agrees with the generic scenario for surface treatment (4.2.2.). Hence, to estimate the expected inhalation exposure the ***inhalation – exposure to vapour - evaporation - increasing release*** is used. The scenario for dermal exposure however is not in agreement with the generic scenario, because the product is used in undiluted form and is touched accidentally. Here, the ***dermal – direct product contact - instant application loading*** is used.

- Application duration

Application duration is interpreted here as the time required to apply the floor seal product to the floor. It is assumed that such an activity is similar to applying liquid polish products to the floor. The default application duration is thus 90 min (Section 11.1.3). The Q-factor is 2, because the underpinning data are not recent and not collected specifically for treating the floor with strip products.

- Product amount -inhalation

The product amount that is available for inhalation is interpreted as the amount floor seal product that is applied on the floor. Product information indicates that the amount required is about 0.04 - 0.1 l per m^2 (Tile & Floor Care, 2016) depending on the porosity of the floor. Floor sealing products are either polyacrylate or water based (Table 11.1). The density of polyacrylate (1220 g/l) is higher than that of water (1000 g/l), so that the maximum amount required to seal a floor of 22 m^2 with polyacrylate based sealer is calculated as 1220 g/l x 0.1 l/m^2 x 22 m^2 = 2684 g and for water based sealer 2200 g. The default product is set to 2.7 kg and 2.2 kg for polyacrylate and water based floor seal product respectively. The Q-factor is 2, because the underpinning data is limited.

- Molecular weight matrix

The fraction of water in polyacrylate floor seal product is estimated at 0.2 (Table 11.1). The molecular weight of polyacrylate however is variable. The molecular weight matrix is thus calculated from its weight fraction of water. Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.2) which yields 90 g/mol. For water based floor seal products the molecular weight matrix is calculated as 18 g/mol divided by 0.8 (Table 11.1) which yields 22 g/mol. The Q-factor is set to 2, because the underpinning data is limited.

- Product amount -dermal

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a calculation for dermal exposure to undiluted products applied in surface treatment. It was assumed that 1% of the total amount that is applied ends up on the hand palms of the consumer. However, this would be a clear overestimation for this specific scenario. Instead it is assumed that the consumer accidentally touches the treated floor with one hand palm (225 cm^2). In order to be conservative it is assumed that the entire amount product on that is in the interface between surface of the floor and that of the consumer's hand leads to dermal exposure. Hence, the amount per m^2 applied on the floor is equal to the amount per m^2 on the palm of the hand of the consumer. For polyacrylate based sealer the default product amount available for dermal exposure is thus calculated as 225 cm^2 x 0.1 l/m^2 x 1220 g/l = 2.75 g and for water base sealer the amount is calculated to be 2.25 g. The Q-factor is set to 1, because it is still conservative to assume that the product amount per m^2 on the treated surface is equal to the amount per m^2 on the exposed area.

Table 11.7: Default values for treating the floor with floor seal products

	Default value	Q-factor	Source
General			
Frequency	1 per year	1	Prud'homme de Lodder et al., 2006a
Inhalation - exposure to vapour evaporation increasing release			
Exposure duration	90 min	3	Application duration
Product amount			
Polyacrylate based	2.7 kg	2	See above

sealer			
Water based sealer	2.2 kg	2	See above
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	22 m^2	2	Scenario
Application duration	90 min	2	Section 11.1.3.
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix			
Polyacrylate based sealer	90 g/mol	2	See above
Water based sealer	22 g/mol	2	See above
Dermal - direct product contact- instant application loading			
Exposed area	225 cm^2	3	One hand palm (Te Biesebeek et al., 2014)
Product amount			
Polyacrylate based sealer	2.75 g	1	See above
Water based sealer	2.25 g	1	See above

11.1.3 *Floor polishes*

Floor polish is used to protect the floor. A relative durable wax coating is applied to keep the floor in a good state. Less cleaning is required and can be performed easier. The coating is applied in an undiluted form by waxing the floor and after drying, a gleaming film is formed. Floor polish contains ingredients such as wax and polymers in different ratios. A longer polishing activity is required in case a polish contains relatively more wax.

The EPHECT (2012) survey shows that only a minor fraction of the consumer population buys floor polish products available on the European market. Floor polish is used by only 14% of the respondents. Most consumers use floor polish weekly (41% use it once or twice a week), or once or twice a month (29%); 18% use the product less often than once a month. Few people use the product daily (7%). Floor polishes are most used for living room floors (68%) and for the floor in the hallway (51%). Consumers in Italy however, most often use the product in bedrooms (72%). Most users prefer the product in liquid format (79%), while wipes are less favoured.

11.1.3.1 Floor polish liquids

Scenarios for consumer exposure

Floor polish liquids are ready-to-use products that are used undiluted. Exposure from mixing and loading is thus not to be considered (4.1.3). Instead, the polish is directly applied to the floor with a squeeze bottle and spread over the floor with a mop. Dermal exposure is anticipated at this moment from spills ending up on the backside of the hand of the consumer, whereas inhalation exposure to volatile substances evaporating from the treated surface is anticipated as well. It is assumed that the consumer directly leaves the room after the floor is treated with floor polish liquid.

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of twice a year. Versar (1992) estimated the frequency at 2 times in 6 months, while Westat (1987) gives a 75th percentile of 6 times per year for wood floor cleaners. However, EPHECT (2012) shows that 46% of the consumers that use floor polish do so weekly. Based on the recent and rich data of EPHECT specifically collected for the use of floor polish, the new default is set at 52 per year with a Q-factor of 4.

11.1.3.1.1 Application: treating the floor with liquid polish

The scenario of inhalation exposure from treating a floor with liquid polish products agrees with the generic scenario for surface treatment (4.2.2.). Hence, to estimate the expected inhalation exposure the ***inhalation – exposure to vapour - evaporation - increasing release*** is used. The scenario for dermal exposure however is not in agreement with the generic scenario, because the product is used in undiluted form and applied to the floor with a squeeze bottle. Here, **the *dermal – direct product contact - instant application loading*** is used.

- Application duration

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 90 min, based on the 75th percentile of Westat (1987). Data of higher quality have not become available ever since. Therefore, the default application duration remains 90 min with a Q-factor of 3.

- Exposure duration

Product information advises the consumer to leave the room once the floor polish liquid is applied. The default for exposure duration is thus set equal to the application duration (Prud'homme de Lodder et al., 2006a). The default remains 90 min. The Q-factor however is set to 2, because the quality of the data is compromised by the assumption that the consumer leaves the room directly after the polishing task.

- Product amount -inhalation

Product information prescribes a use of 20-25 g per m^2 (RigoStep, 2012. The surface area of the floor is 22m^2, so that product amount required is maximally 550 g, which agrees with the default in the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a). The default thus remains 550 g. The Q-factor however is lowered to 2, because the underpinning data from product information is quite limited.

- Molecular weight matrix

The water fraction in liquid floor polish is about 0.8 (Table 11.1). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.8) which yields 22 g/mol. The Q-factor is 2, because the underpinning quantitative data is limited.

- Product amount -dermal

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a calculation for dermal exposure to undiluted products applied in surface treatment. It was assumed that 1% of the total amount that is applied ends up on the hand palms of the consumer. However, this would be a clear overestimation for this specific scenario. Instead it is assumed that the consumer accidentally touches the treated floor with one hand palm (225 cm^2). In order to be conservative it is assumed that the entire amount product that is on the interface between surface of the floor and that of the consumer's hand leads to dermal exposure. Hence, the amount per m^2 applied on the floor is equal to the amount per m^2 on the palm of the hand of the consumer. For floor polish the default product amount available for dermal exposure is thus calculated as 225 cm^2 x 25 g/m^2 = 0.55 g. Q-factor is set to 1, because it is still conservative to assume that the product amount per m^2 on the treated surface is equal to the amount per m^2 on the exposed area.

Table 11.8: Default values for treating a floor with floor polish

	Default value	Q-factor	Source
General			
Frequency	52 per year	4	EPHECT 2012
Inhalation - exposure to vapour- evaporation- increasing release			
Exposure duration	90 min	2	See above
Product amount	550 g	2	See above
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room Te Biesebeek et al., 2014)
Release area	22 m^2	4	Living room (Te Biesebeek et al., 2014)
Application duration	90 min	3	Westat 1987
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	22 g/mol	2	See above
Dermal - direct product contact- instant application loading			
Exposed area	225 cm^2	3	Hand palm (Te Biesebeek et al., 2014)
Product amount	0.55 g	1	See above

11.1.3.2 Floor polish spray

Scenarios for consumer exposure

Floor polish sprays are ready-to-use products that are on the market as aerosol cans and trigger sprays. They are used undiluted. Exposure from mixing and loading is thus not to be considered (4.1.3). Instead the consumer directly sprays the floor polish onto the floor of an unspecified room (8 m^2) and starts to polish it. First, the product is sprayed onto the surface. At this moment inhalation exposure is anticipated by inhaling the spray cloud and dermal exposure is anticipated from deposition of the spray cloud to the consumer's skin. Next, the consumer polishes the surface by rubbing the sprayed product with a cloth. In case of volatile substances, evaporation from the treated surface during the rubbing activity is not considered, because inhalation exposure to the volatile substance in spray is already covered in the instantaneous exposure estimate for the spraying activity (4.2.2.). Additional dermal exposure from rubbing however is anticipated via hand contact with the product. Once the floor is polished, the consumer is expected to leave the room, therefore secondary exposure is not considered.

11.1.3.2.1 Application: spraying the polish on the floor

Inhalation exposure to non-volatile substance available as sprayed particles is estimated with the ***inhalation – exposure to spray – spraying release***. The dermal exposure is estimated with the ***dermal – direct product contact - constant rate loading*** (4.2.1). The defaults for the parameters mass generation rate, airborne fraction, density non-volatiles and contact rate area are in accordance with the generic scenario (4.2.1).

- Spray duration

The spray duration is calculated from the amount of product that needs to be applied to the surface. It is assumed that polish spray is just as effective as polish liquids, so that the respective required product amounts per m^2 are equal. The floor is 8 m^2 and the product amount of polish liquid per m^2 is 20-25 g (11.1.3.1.1), so that a product amount of 200 g spray polish is estimated. The mass generation rate of a trigger is 1.6 g/s and for a spray can 1.2 g/s. Hence, 125 s are needed for a trigger spray and 167 s for a spray can to spray the entire floor. The spray duration for trigger sprays and spray cans is thus set at 125 s and 167 s, respectively. The Q-factor is 2, because the underpinning data is limited.

- Exposure duration

The exposure duration is interpreted here as the duration of the polishing task. It is assumed that polishing a floor with spray proceeds just as effectively as polishing a floor with liquid. Polishing a floor with liquid with on a mop proceeds with 0.25 m^2 per min, since a floor of 22 m^2 takes 90 min to polish (11.1.3.1.1). Polishing a floor with spray however is performed with a cloth, which takes longer. It is therefore assumed that polishing 8 m^2 by hand requires 90 min. The default exposure duration is thus set to 90 min. The Q-factor is 1, because the default is based on expert judgement.

- Mass generation rate

The floor polish is applied with a trigger spray or aerosol spray can, which generically have a mass generation rate of 1.6 and 1.2 g/s, respectively (4.2.1). The Q-factor is 3, because the underpinning quantitative data is generically collected for trigger sprays and aerosol spray cans and not specifically collected for floor polish sprays.

- Initial Particle Distribution

Delmaar & Bremmer (2009) experimentally derived the particle size distribution of droplets released by spray can with furniture polish. They found a lognormal distribution with a median of 10.8 µm and a c.v. of 0.81. The default initial particle distribution is set accordingly for floor polishes. The Q-factor is set to 2, because the data is specifically collected for furniture polish and is limited to 5 measurements on 2 samples.

Table 11.9: Default values spraying floor polish

	Default value	Q-factor	Source
General			
Frequency	52 per year	4	EPHECT, 2012
Inhalation - exposure to spray - spraying release			
Spray duration			
Trigger sprays	125 s	2	See above
Aerosol cans	167 s	2	See above
Exposure duration	20 min	1	See above
Room volume	20 m^3	4	Unspecified room (Te Biesebeek et al., 2014)
Room height	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate	0.6 hour	3	Unspecified room (Te Biesebeek et al., 2014)
Mass generation rate			
Trigger spray	1.6 g/s	3	Section 4.2.1
Aerosol can	1.2 g/s	3	Section 4.2.1
Airborne fraction	0.2	3	Section 4.2.1
Density non-volatile	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution			
Median (c.v.)	10.8 µm (0.81)	3	Delmaar & Bremmer, 2009
Inhalation cut-off diameter	15 µm		Delmaar & Schuur, 2016
Dermal - direct product contact- constant rate			
Contact rate			
Trigger sprays	46 mg/min	3	Section 4.2.1
Aerosol can	100 mg/min	3	Section 4.2.1
Release duration			
Trigger sprays	125 s	3	Spray duration
Aerosol spray cans	167 s	3	Spray duration

11.1.3.2.2 Application: polishing the sprayed floor

Additionally to the dermal exposure from deposition of sprayed aerosols to the skin of the consumer, dermal exposure by hand contact while rubbing the surface is expected. Polishing the surface agrees with the generic scenario for surface treatment (4.2.2). Therefore, the ***dermal – direct product contact - instant application loading*** is used to estimate the dermal exposure via hand contact while rubbing the surface. In case of volatile substances, evaporation from the treated surface during the rubbing activity is not considered, because inhalation exposure to the volatile substance in spray is already covered in the instantaneous exposure estimate for the spraying activity (4.2.2.).

- Product amount -dermal

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a calculation for dermal exposure to undiluted products applied in surface treatment. It was assumed that 1% of the total amount that is applied ends up on the hand palms of the consumer. However, this would be a clear overestimation for this specific scenario. Instead it is assumed that the amount per m^2 applied on the floor is equal to the amount per m^2 on the palm of the hands of the consumer. For floor polish the default product amount available for dermal exposure is thus calculated as 225 cm^2 x 25 g/m^2 = 0.55 g (11.1.3.2). The Q-factor is set to 1, because it is still conservative to assume that the product amount per m^2 on the treated surface is equal to the amount per m^2 on the exposed area.

Table 11.10: Default values for floor spray rubbing and polishing

	Default value	Q-factor	Source
General			
Frequency	52 per year	4	EPHECT, 2012
Dermal -direct product contact- instant application loading			
Exposed area	225 cm^2	3	One handpalm (Te Biesebeek et al., 2014)
Product amount	0.55 g	1	See above

11.1.4 *Floor wet wipes*

Scenarios for consumer exposure
Floor wet wipes are taken from the package and mounted on a mop head. Dermal exposure is expected from mounting the wipe via contact with the inside of the consumer's hand. Once the wipe is mounted, the consumer starts to clean the floor in unspecified room. At this moment inhalation exposure is anticipated as volatile substances evaporate from the floor surface. After the cleaning task the consumer stays in the room for 4 hours.

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 104 per year, based on the typical AISE (2002) value for cleaning furniture. Analysis of EPHECT data (2012) shows a 75th percentile 66 per year for cleaning a floor with wet wipes (Annex II). The new default is based on the high quality data of EPHECT that is recent, rich in data and specifically collected for floor cleaning with wet wipes. Hence, the Q-factor is 4.

11.1.4.1 Application: mounting a wet wipe and cleaning the floor

Dermal exposure is estimated for the hand contact with the wet wipe upon mounting the wipe on the mop head. Inhalation exposure is estimated for cleaning the surface. The ***dermal - direct product contact - instant application loading*** is used to estimate dermal exposure, whereas inhalation exposure is estimated with the ***inhalation - exposure to vapour-evaporation - increasing release***.

- Application duration

According to AISE (2014), the duration of a cleaning task with floor wipes takes 2 to 10 minutes (AISE, 2014) with a typical duration of 5 min. The new default value is set at 10 min. The Q-factor is 3. Although the data is specifically collected for wet floor wipes, important context data such as the treated surface area is not given, e.g. a larger surface area takes longer to clean.

- Exposure duration

According to the scenario, the consumer stays for 4 hours after the cleaning task. The default is thus set 240 min with a Q-factor of 1.

- Product amount -inhalation

The product amount that is available for inhalation is interpreted here as the amount that is applied on the floor. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 25 g. AISE (2014) presents a typical amount of 26 g per task. Analysis of the EPHECT data (2012) shows a 75th percentile value of 19 g (Annex II). The new default is set at 20 g based on the high quality data of EPHECT that is recent, data rich and specifically collected for floor cleaning with wet wipes. However, important context data such as the treated surface area is not given, i.e. a larger surface area requires more product amount. Therefore, the Q-factor is set to 3.

- Molecular weight matrix

According to the general composition of floor wet wipes, the fraction of water in the liquid is 0.5. Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.5) which yields 36 g/mol. The Q-factor is 2, because the underpinning quantitative data is limited.

Table 11.11: Default values floor mopping systems: wet wipes

	Default value	Q-factor	Source
General			
Frequency	66 per year	4	EPHECT 2012
Inhalation - exposure to vapour-evaporation-increasing release			
Exposure duration	240 min	1	Scenario
Product amount	20 g	3	Annex II
Room volume	20 m^3	3	Unspecified room (Te Biesebeek et al., 2014)
Ventilation rate	0.6 per hour	3	Unspecified room (Te Biesebeek et al., 2014)
Release area	8 m^2	3	Unspecified room (Te Biesebeek et al., 2014)
Application duration	10 min	3	AISE, 2014
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	36 g/mol	2	See above
Dermal - direct product contact - instant application loading			
Exposed area	225 cm^2	3	Inside hand (Te Biesebeek et al., 2014)
Product amount	0.05 g	3	Section 4.2.2.1

11.1.5 *Cartridge floor mopping systems*

Scenario
The consumer mounts a cartridge with cleaning product on the mop system. Exposure is not anticipated at this moment, because the cleaning product is still in the enclosed water reservoir of the mop system. Next, the consumer pulls a trigger on the mop stick releasing the cleaning product that is diluted in the water reservoir on the living room floor. The consumer then continuously applies cleaning product with the liquid and mops it over the living room floor. Once the floor is cleaned the cleaning pad is removed from the mop system. Dermal exposure is anticipated at this moment via contact with the inside of the consumer's hand. After cleaning, the consumer stays in the room for at least 4 hours.

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 104 per year. According to AISE (2014) surface cleaners are used 1 to 7 times per week with a typical frequency of 2 times per week (104 per year). Weegels reports a 75th percentile of 320 per year but that also includes the cleaning of other rooms (Weegels, 1997). Analysis of EPHECT (2012) data resulted in a 75th percentile for the use frequency of floor cleaning liquids of 161 per year. Based on recent data and number of data points (n=1333). The new default is set at 161 per year based on the high quality data of EPHECT that is recent, rich in data but not specifically collected for floor cleaning with cartridge systems. Hence, the Q-factor is 3.

11.1.5.1 Application: cleaning the floor and removing the pad

Once the product is applied to the floor, inhalation exposure to floor cleanings liquid in a cartridge mop system becomes similar to the expected inhalation exposure to regular floor cleaning liquids (11.1.1). This is not the case for dermal exposure. Dermal exposure to regular floor cleaning liquids occurs via dipping the hands and forearms in water that contains the cleaning liquid, whereas dermal exposure when using the cartridge system is only expected for removing the pad. Exposure is estimated with the ***inhalation - exposure to vapour- evaporation-increasing release*** (11.1.1) and the ***dermal - direct product contact - instant application loading***.

- Product amount -dermal

The product amount that is available for dermal exposure is calculated from the volume of water that is in contact with the skin and the concentration of the floor cleaning product in the water. It is assumed that the concentration of cleaning liquid in the water of a cartridge system is equal to the concentration of regular floor cleaning liquids diluted in a bucket with water: 16.4 g/l (11.1.1). A volume of 2.25 ml water on the skin is calculated by multiplying the exposed area, inside of the hand is 225 cm^2 (Te Biesebeek et al., 2014), with a layer thickness of 0.01 cm (ECHA, 2015a). Hence, the default for product amount available for dermal exposure is calculated as 2.25 ml x 16.4g /l = 0.04 g. The Q-factor is set to 2, because the underpinning data is limited.

Table 11.12: Default values for floor ready to use mopping systems: cleaning

	Default value	Q-factor	Source
General			
Frequency	161 per year	4	Section 11.1.1
Inhalation - exposure to vapour- evaporation-increasing release			
Exposure duration	240 min	1	Section 11.1.1
Product amount	15 g	2	Section 11.1.1
Room volume	58 m^3	4	Section 11.1.1
Ventilation rate	0.5 per hour	3	Section 11.1.1
Release area	22 m^2	2	Section 11.1.1
Application duration	20 min	3	Section 11.1.1
Temperature	20 °C	4	Section 11.1.1
Mass transfer coefficient	10 m/h	2	Section 11.1.1
Molecular weight matrix	22 g/mol	2	Section 11.1.1
Dermal - direct product contact - instant application loading			
Exposed area	225 cm^2	3	Inside hand (Te Biesebeek et al., 2014)
Product amount	0.04 g	2	See above

11.2 Carpet products

Carpet cleaners are developed for cleaning all kinds of carpets, rugs and upholstery. They dissolve oily and greasy soils. The cleaning solution or foam loosens the dirt from the fibers, coats the dirt particles and keeps the carpets cleaner for a longer time. A wide variety of carpet-cleaning products exists, ranging from liquids, ready-to-use sprays, powders and aerosols. Carpet cleaning products can be applied manually or with a cleaning machine.

Table 11.13: General composition of carpet cleaners

Carpet cleaner	Liquid[A] %	Powder[A] %	Shampoo[B] %	Spot remover[A], liquid %
Surfactants				0->30
Anionic	0-15	1-5	1-5	
Non-ionic	0-15			
Builders	0-5			
polycarboxylates			0-2	
Solvents & hydrotropes				
Ethanol/ isopropylalochol	0->30	7-14		30-40
Glycols/ glycolethers				0-15
Additives				
Polymers				
Foam stabilizers				

Preservatives	<1			
Colorants	<1	<1	<0.02	
Fragrances		15-60	<1	
Carriers				
Propellants				
Water	60-90	40-80	90	

[A] composition adopted from Prud'homme de Lodder et al. (2006a)
[B] wwww.cleanright.eu

11.2.1 *Carpet cleaning liquids*

Scenarios for consumer exposure
Carpet cleaning liquids are diluted with water before they are applied to the carpet either manually or with a machine. The anticipated exposure for loading a machine or a bucket for manual cleaning is considered to be similar, because both activities agree with the generic scenario for loading liquids (4.1.2). Once the carpet cleaning liquid is diluted, the consumer starts to treat the carpet. Manual treatment is by rubbing the product into the carpet with a brush or sponge. Machine cleaning is done with a machine that continuously sprays and vacuums the cleaning dilution back into the reservoir. Cleaning the carpet with a machine requires less time and leaves lower amounts of residue. Except, for the application and exposure duration however, inhalation and dermal exposure are estimated to be similar for manual and machine cleaning. Dermal exposure is estimated with the concentration of product in the water that ends up on the hands of the consumer. This volume of water is estimated from the exposed skin area and a water layer thickness of 0.01 cm (ECHA, 2015). While manual cleaning the hands and forearms are dipped under water in the bucket, whereas upon machine cleaning the hands and forearms are dipped under water in the machine reservoir. The carpet that is treated with the carpet cleaning liquid is an accessible surface for small children. Therefore, dermal exposure may occur by rubbing off the product (4.3.1) and oral exposure from hand-to-mouth behaviour (4.3.2).

- Frequency

Garcia-Hidalgo et al. (2017) present summary data from which it is derived that the respondent representing the 75th percentile would declare to clean a rug or carpet once a week. It would take the respondent '10-30 min per task' or '1-10 min per day'. Hence, the summary data of Garcia-Hidalgo proves to be consistent with respect to frequency and duration of cleaning a carpet or rug. Data other than product information recommending cleaning the carpet at least once a year is not available. The default frequency is therefore based on the survey of Garcia-Hidalgo et al. (2017) and set to 52 per year. The Q-factor is set to 4, because the data source is quantitatively rich, internally consistent and specifically collected for the frequency of cleaning a carpet.

11.2.1.1.1 Mixing & Loading: loading of liquid carpet cleaner

During opening of the bottle and the pouring of carpet cleaning liquids into a bucket or machine reservoir, volatiles evaporate from the bottle into the personal breathing zone of the consumer. Meanwhile spilled droplets end up on the backside of the pouring hand. To estimate exposure the expected exposure the ***inhalation – exposure to vapour - evaporation - constant rate*** and ***dermal – direct product contact - instant application loading*** are used (see section 4.1.2.). Defaults for the parameters product amount (inhalation), exposure duration, room volume, release area, application duration, exposed area and product amount (dermal) are described in the generic scenario (4.1.2).

- Molecular weight matrix

The fraction of water in the carpet cleaning liquid is estimated at 0.6 (Table 11.13). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.6) which yields 30 g/mol. The Q-factor is 2, because the underpinning quantitative data is limited.

Table 11.14: Default values for carpet cleaning liquid; mixing and loading manual

	Default value	Q-factor	Source
General			
Frequency	52 per year	4	Garcia-Hidalgo et al., 2017
Inhalation - exposure to vapour- evaporation- constant release			
Exposure duration	0.75 min	3	Section 4.1.2
Product amount	500 g	3	Section 4.1.2
Room volume	1 m^3	3	Section 4.1.2
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Application duration	0.3 min	3	Section 4.1.2
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	30 g/mol	2	See above
Dermal - direct product contact - instant application loading			
Exposed area	225 cm^2	3	Section 4.1.2
Product amount	0.01 g	3	Section 4.1.2

11.2.1.1.2 Application: cleaning the carpet with liquid

Inhalation and dermal exposure are estimated to be similar for manual and machine cleaning, except for the application and exposure duration. The exposure is estimated using the ***inhalation – exposure to vapour – evaporation - increasing release*** and ***dermal instant – direct product contact – instant application loading***.

- Application duration

By expert judgment it is determined that cleaning a carpet manually takes 5 min per m^2 and 2.5 min per m^2 for machine cleaning. The default application durations for cleaning a carpet of 22 m^2 manually or by machine are thus calculated to be 110 min and 55 min, respectively. The Q-factors are set to 1, because the defaults fully depend on expert judgment.

- Exposure duration

The consumer is expected to leave the room after cleaning the carpet. Therefore, the defaults exposure durations for manually and machine cleaning a carpet are set equal to the respective application durations of 110 and 55 min. The Q-factors are set to 1, because the defaults fully depend on expert judgment.

- Product amount -inhalation

The product amount that is available for inhalation is interpreted here as the amount of carpet cleaning liquid used. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a product use of 0.025-0.03 l per m^2, which agrees with the recommend use amount in recent product information: 1l of carpet cleaning liquid cleans about 37.5 m^2 (Rug Doctor, 2016). It can be assumed that the density of carpet cleaning liquid is 1000 g/l, since it mainly consists of water (Table 11.13). The product amount that is available for inhalation is thus calculated as 0.03 l/m^2 x 22 m^2 x 1000 g/l = 660 g. The Q-factor is set to 2, because the underpinning data collected from product information is limited.

- Dilution factor

The dilution factor refers to the ratio of the product amount and the total mass of the substance in which it is diluted (4.2.3). Here, the product is diluted in the water in the reservoir of the carpet steamer which is estimated to be 10 l in volume and thus 10 kg in mass, see below. Hence, the dilution factor is calculated to be 0.066 by dividing the product amount with 10 kg of water. The Q-factor is set to 2, because the calculation is not entirely based on expert judgement but lacks underpinning with quantitative data.

- Product amount -dermal

The product amount that is available for dermal exposure is interpreted here as the product amount that is in contact with the hands and forearms of the consumer. However, the carpet cleaning liquid is diluted with water before use. The product amount that is available for dermal exposure is therefore calculated from the volume of water that is in contact with the skin and the concentration of the carpet cleaning liquid in the water. The concentration is calculated by dividing the used product amount of 660 g (see above) with the volume of water it is diluted in. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a dilution with 10 l water for both manual and machine cleaning. The concentration in the water is thus calculated to be 66 g/l, i.e. 660 g/10 l. According to the generic scenario for application of diluted products, the volume of water left on the skin after dipping hands and forearms under water is 22 ml (4.2.3). The product amount that is available for dermal exposure is therefore calculated as 66 g/l x 22 ml =1.45 g. The Q-factor is 2, because product information on carpet cleaning machines explains there are small carpet cleaners with a reservoir of 0.35 to 1.4-1 l (SteamInsider, 2017) and large carpet cleaner with a reservoir of 30-45 l (Kaercher, 2017a, b) Here, it is assumed that a volume of 10 l is representative for both small and large machine reservoirs as well as the volume of water in a bucket for manual cleaning. Hence, the calculation of the default product amount for dermal exposure can be improved by further specification.

Table 11.15: Default values for carpet cleaning liquid; manual cleaning

	Default value	Q-factor	Source
General			
Frequency	52 per year	4	Garcia-Hidalgo et al. (2017)
Inhalation - exposure to vapour- evaporation increasing release			
Exposure duration			
Manual cleaning	110 min	1	Prud'homme de Lodder et al., 2006a
Machine cleaning	55 min	1	Prud'homme de Lodder et al., 2006a
Product amount	660 g	3	See above
Dilution factor	0.066	2	See above
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	22 m^2	4	Living room (Te Biesebeek et al., 2014)
Application duration			
Manual cleaning	110 min	1	Prud'homme de Lodder et al., 2006a
Machine cleaning	55 min	1	Prud'homme de Lodder et al., 2006a
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal - direct product contact - instant application loading			
Exposed area	2200 cm^2	3	Hands + forearms (Te Biesebeek et al., 2014)
Product amount	1.5 g	2	See above

11.2.1.2 Secondary exposure: rubbing off carpet cleaning liquid from treated surface

Secondary exposure for small children crawling over the treated carpet is estimated according to the generic scenario for rubbing off (4.3.1). Hence, the ***dermal – direct product contact – rubbing off loading*** is used to estimate dermal exposure and the ***oral-direct product contact -direct oral intake*** is used to estimate oral exposure from hand-to-mouth behaviour (4.3.2).

- Contacted surface (S_{area})

The contacted surface (S_{area}) is the area of the treated surface that can potentially be rubbed, which is in this scenario the floor of a living room 22 m^2 (Te Biesebeek et al., 2014). The default is thus set to 22 m^2 and the Q-factor is set to 4, because it is underpinned with quantitatively rich data that is specifically collected to characterize the surface area of a living room floor.

- Dislodgeable amount ($F_{dislodge}$)

As described in the generic scenario (4.3.1), the dislodgeable amount is calculated by multiplying a fraction of 0.3 with the used product amount (g) per contact surface area (/m^2). The dislodgeable amount is thus calculated as 0.3 x 660 g/ 22 m^2 = 9 g/m^2. The Q-factor is set to 2, because the underpinning quantitative data is limited.

Table 11.16: Default values for carpet cleaning liquids secondary exposure

	Default value	Q-factor	Source
General			
Frequency	52 per year	4	Garcia-Hidalgo et al., 2017
Body weight	9 kg	4	4.3.1
Dermal – direct product contact – rubbing off loading model			
Contacted surface	22 m^2	4	Te Biesebeek et al., 2014
Dislodgeable amount	9 g/m^2	2	See above
Transfer coefficient	0.2 m^2/hr	3	Section 4.3.1
Contact time	60 min	1	Section 4.3.1
Exposed Area	0.3 m^2	4	Section 4.3.1
Oral-direct product contact -direct oral intake model			
Ingested amount	10% of the total external dose	1	Section 4.3.2.

11.2.2 *Carpet powders*

Carpet cleaners are also available as moist powders that contain water, solvents and surfactants to emulsify dirt. Product residues are removed with a vacuum cleaner once the dirt is absorbed onto the powder and the carpet is dry.

Scenarios for consumer exposure
Carpet powder is considered to be a ready-to-use product, since the consumer directly scatters the powder from the packaging to the surface that is to be cleaned. Therefore, there is no exposure considered from mixing and loading (4.1.3.). The powder is scattered for carpet of 22 m^2 in the living room. Directly after scattering, the consumer brushes the powder into the carpet's fibre structure. Dermal exposure is expected during brushing via hand contact. Next, the powder is left on the carpet for a period of 20 min in order for the product to absorb and emulsify dirt. Inhalation exposure is anticipated during leave-on, because volatile substances in the moist powder evaporate from the carpet. After leave-on, the powder is removed with a vacuum cleaner. Secondary exposure is anticipated nonetheless, because of the treated carpet is in reach of small children and residues may still be present after vacuum cleaning.

- Frequency

The frequency of cleaning a carpet is estimated from the summary data of Garcia-Hidalgo et al. (2017) to be 52 per year (11.2.1).

11.2.2.1 Application: scattering carpet powder

ConsExpo Web does not possess a specific model to simulate exposure from scattering powders (Delmaar & Schuur 2016). In contrast to abrasive scatter powders used in the kitchen (9.1.1), carpet powders mainly consist of volatile substances (Table 11.11). Therefore, the ***inhalation - exposure to vapour – evaporation- increasing release area*** is used to estimate inhalation exposure to carpet powders. For the estimation of dermal exposure the ***dermal – direct product contact - constant rate loading*** is used.

- Application duration

Application duration is interpreted here as the time required for the consumer to scatter and brush the powder into the carpet's fibre structure. It is assumed that scattering a powder upon a kitchen (9.1.1) is performed just as effective as scattering a powder over and brushing into a carpet. Hence, in 1 min 2 m^2 surface is scattered (9.1.2). The carpet is 22 m^2, so that it takes 11 min to scatter powder upon it. The default is thus set to 11 min. The Q-factor is 2, because the underpinning data is limited.

- Exposure duration

Exposure duration is interpreted here as the required time for the consumer to scatter the powder over the carpet plus a leave-on period of 20 min (Vanish, 2017). It is assumed the consumer brushes the carpet during leave-on, so that no additional exposure duration from a brushing task is considered. Hence, the default exposure duration is set to 30 min. The Q-factor is 2, because the underpinning data is limited.

- Product amount -inhalation

The product amount that is available for inhalation is calculated as the amount of powder that is scattered over the carpet. The previous Cleaning Product Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 50-100 g per m^2, which still agrees with recent product information (Vanish, 2017). The carpet is 22 m^2, so that 2200 g of powder is scattered. The default product amount that is available for inhalation is thus 2.2 kg. The Q-factor is 2, because the underpinning data is limited.

- Molecular weight matrix

The fraction of water in the carpet powder is estimated at 0.4 (Table 11.13). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.4) which yields 45 g/mol. The Q-factor is 2, because the underpinning quantitative data is limited.

- Contact rate

It is assumed that the contact rate of 5 mg/min derived in the generic scenario for loading powders also applies for scattering powders over a carpet. The default is set to 5 mg/min. The Q factor is 1, because it is unclear whether dermal contact from loading powders is comparable to dermal contact from brushing of scattered powders.

Table 11.17: Default values for carpet powder cleaning

	Default value	Q-factor	Source
General			
Frequency	52 per year	4	Garcia-Hidalgo et al. (2017)
Inhalation - exposure to vapour – evaporation - increasing release area			
Application duration	11 min	2	See above
Product amount	2.2 kg	2	Prud'homme de Lodder et al., 2006a
Room volume	58 m^3	3	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Temperature	20 °C	4	Room temperature
Exposure duration	30 min	2	See above
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	45 g/mol	2	See above
Dermal - direct product contact - constant release loading			
Release duration	11 min	2	Application duration
Contact rate	5 mg/min	1	Section 4.1.1.

11.2.2.2 Secondary exposure: rubbing off carpet powder from treated surfaces

The carpet that is treated with carpet powder is an accessible surface for small children that may be dermally exposed by rubbing off the product from the carpet. This form of secondary exposure is estimated with the *dermal – direct product contact – rubbing off loading* mode according to the generic scenario for rubbing off (4.3.1). The *oral-direct product contact -direct oral intake mode* is used to calculate oral exposure from hand-to-mouth behaviour (4.3.2).

- Contacted surface (S_{area})

The contacted surface (S_{area}) is the area of the treated surface that can potentially be rubbed, which is in this scenario the floor of a living room 22 m^2 (Te Biesebeek et al., 2014). The default is thus set to 22 m^2 and the Q-factor is set to 4, because it is underpinned with quantitatively rich data that is specifically collected to characterize the surface area of a living room floor.

- Dislodgeable amount ($F_{dislodge}$)

As described in the generic scenario (4.3.1), the dislodgeable amount is calculated by multiplying a fraction of 0.3 with the product amount (g) per contact surface area (1/m^2). The carpet is vacuum cleaned after the treatment with carpet powder. There is no data available about the amount of residues that stays on the carpet. It is thus assumed that 10% of the product amount is still on the carpet after vacuum cleaning. Hence, the dislodgeable amount is 0.3 x (2200g / 22 m^2) x 10% = 3 g/m^2. The Q-factor is set to 1, because assumption of 10 % residue after vacuum cleaning is based on expert judgement only.

- Contact time (*t*)

It is assumed that a child of 12 months crawls over a cleaned floor for 1 hour a day. The default is 60 min with a Q-factor of 2 (Prud'homme de Lodder et al., 2006a).

Table 11.18: Default values for liquid all-purpose cleaners: secondary exposure

	Default value	Q-factor	Source
General			
Frequency	52 per year	2	Garcia-Hidalgo et al., 2017
Body weight	9 kg	4	Section 4.3.1
Dermal – direct product contact – rubbing off loading model			
Contacted surface	22 m^2	4	Te Biesebeek et al., 2014
Dislodgeable amount	3 g/m^2	1	See above
Transfer coefficient	0.2 m^2/hr	3	Section 4.3.1
Contact time	60 min	2	Prud'homme de Lodder et al., 2006a
Exposed Area	0.3 m^2	4	Section 4.3.1.
Oral-direct product contact -direct oral intake model			
Ingested amount	10% of the total external dose		Section 4.3.2.

11.2.3 *Carpet spot removers*

Carpet spot removers eliminate small stains and dirt from carpets and upholstery.

Scenarios for consumer exposure

The consumer uses a spray can that contains a foam spot remover to treat the carpet in the living room. The spray can is a ready-to-use product, so that exposure from mixing and loading is not considered (4.1.3). The user sprays the spot remover on an area of 0.1 m^2. The foam is left on the stain to soak for 5 min. Inhalation exposure is anticipated during leave-on as volatile substances may evaporate from the stain. Next, the dirt is absorbed with (paper) towels and the surface is patted dry. Dermal exposure is expected from rubbing the carpet with towels.

- Frequency

Westat (1987) investigated spot removers in a national survey and presents for use frequency a 75^{th} percentile value of 10 times a year. The default remains 10 per year with a Q-factor of 3.

11.2.3.1 Application: leave-on and rubbing in carpet spot remover

Inhalation exposure during leave-on is estimated with the ***inhalation - exposure to vapour – evaporation***. Dermal exposure from rubbing is estimated with the ***dermal – direct product contact - instant application - loading***.

- Product amount -inhalation

The product amount that is available for inhalation is interpreted here as the amount that is needed to treat the stain. Product information recommends an amount of 40 to 77 g per m^2. A stain of 0.1 m^2 thus requires 8 g. The default is thus set at 8 g. The Q-factor is 2, because the underpinning data based on product information is limited.

- Emission duration

Emission duration is interpreted here as the leave-on time in which the spot remover is left on the stain to soak. Product information recommends that the stain needs to be soaked for 1-5 min (Vanish, 2017). The default is set at 5 min to include the maximal duration of recommended use. The Q-factor is set to 2, because the data from product information is limited.

- Exposure duration

Exposure duration is interpreted here as the leave-on time plus the time the consumer needs to remove the spot with a towel. It is assumed that the duration for spot treatment of laundry products also applies for carpet products. According to AISE (2014), a laundry pre-treatment takes 10 min per task (6.3.2). The default for exposure duration is set to 15 min. The Q-factor is set to 2, because the product information underpinning the leave-on time is limited and it is not clear to what extent the duration of spot treatment in laundry can be extrapolated to carpet products.

- Molecular weight matrix

The fraction of ethanol in the spot remover is estimated at 0.4 (Table 11.13). The molecular weight matrix is thus calculated as 46 g/mol divided by 0.4, 115 g/mol. The Q-factor is set to 2.

- Product amount -dermal -non-volatile substances

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a calculation for dermal exposure to undiluted products applied in surface treatment. It was assumed that 1% of the total amount that is applied ends up on the hand palms of the consumer. However, it is unclear whether this assumption is plausible for this specific scenario. Instead it is assumed that the amount per m^2 applied on the stain is equal to the amount per m^2 on the exposed skin area of the consumer. The exposed skin area is calculated as five fingers, because the rest of the hand is protected by the towel. For spot remover the default product amount available for dermal exposure is thus calculated as (7 g / 0.1 m^2) x 75 cm^2= 0.5 g. The Q-factor is 1, because it is blunt to assume that the amount per m^2 applied on the stain is equal to amount per m^2 on the exposed skin.

- Exposed area

The exposed area is considered to be the top phalanges of all five fingers of one hand. The General Fact Sheet describes a default surface area of a hand to be 450 cm^2 (Te Biesebeek et al., 2014). The surface area of fingers is then 225 cm^2 assuming they represents half the surface area of the hand. The surface area of one finger is then 45 cm^2 and one phalanx 15 cm^2 and five phalanges 75 cm^2. The default is thus set to 75 cm². The Q-factor is set to 3, because the underpinning data is quantitatively rich but rather compromised by the calculation described.

Table 11.19: Default values for carpet spot removers

	Default value	Q-factor	Source
General			
Frequency	10 per year	3	Westat 1987
Inhalation - exposure to vapour – evaporation			
Emission duration	5 min	2	Product information
Product amount	8 g	2	Product information
Room volume	58 m^3	3	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Temperature	20 °C	4	Room temperature
Exposure duration	15 min	2	See above
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	115 g/mol	2	See above
Dermal - direct product contact - instant application loading			
Exposed area	75 cm^2	3	See above
Product amount	0.5 g	1	See above

11.3 Furniture and leather products

Furniture and leather products are intended to remove dust and stains, to protect wooden floors, various furniture, leather clothes and shoes and to produce shine afterwards. There are products with a wax finish, oil finish or varnish. The products are available as liquids, sprays or pastes.

Table 11.20: General composition of furniture and leather products

Cleaning and caring products	Furniture Liquid[A] %	Furniture Spray[A] %	Wood Liquid[B] %	Wood spray[B] %	Leather Foam[B] %
Surfactants					
Anionic					5-20
Non-ionic			1-10	0-2	1-5
soap			1-5		
Waxes	51			0-2	1-5
Oil, turpentine oil, mineral oil	22	<10			
Solvents			1-5	10-15	0-1
Naphtha, petroleum distillate	20	<20			
Additives					
Silicones				0.5-2	
Colorants			0-0.1		
Fragrances			<1	0-1	
Preservatives			<0.5	0-1	
Hydrotropes			0-0.5		
Polymers					<5[A*]

Glycerine					1-5[A*]
Stearic acid	7				
Propellants		<18		10-20	10-20
Water		55-65	80	55-65	60-80

[A] composition adopted from Prud'homme de Lodder et al. (2006a) [*]liquid products
[B] www.cleanright.eu

11.3.1 *Furniture spray polish*

Furniture sprays are on the market as aerosol cans and trigger sprays. The consumer treats a small cupboard with a total area of 8 m^2 with a spray can containing furniture polish. The sprays are ready-to-use products that are used undiluted. Exposure from mixing and loading is thus not to be considered (4.1.3). First, the product is sprayed upon the cupboard. During spraying, inhalation exposure is anticipated as airborne droplets entering the breathing zone, whereas dermal exposure is expected as well from droplets depositing to the unprotected skin of the consumer. Next, the polish is rubbed over the cupboard with a cloth. In case of volatile substances evaporation from the treated surface during the rubbing activity is not considered, because inhalation exposure to the volatile substance in spray is already covered in the instantaneous exposure estimate for the spraying activity (4.2.2.). However, during rubbing dermal exposure is also expected via hand contact with a contaminated cloth and due to spills. The treated surface is not in reach of small children, so that secondary exposure is not expected.

- Frequency

Furniture polish can be used for maintenance and care or for impregnation of recently purchased wooden furniture. The frequency for both uses differ, because polish used for maintenance and care is used in small amounts to treat scratches and other damages, whereas impregnation is used for the entire piece of furniture. The EPHECT (2012) survey reports sufficient summary data to estimate the 75th percentile for the frequency of using small amounts (5 sprayings) furniture polish (Table 11.21). According to the cumulative percentage, the 75th percentile is represented with the questionnaire answer "once a week". This in contrast to the summary data of Garcia-Hidalgo et al. (2017) from which it can be derived that the respondent representing the 75th percentile would answer ' once per year', which typically reflects the use frequency of impregnation products prescribed by product information (Onderhouders.nl, 2016). The exposure scenario describes the treatment of the entire cupboard. Hence, the summary data of Garcia-Hidalgo et al. (2017) resembles the described exposure scenario most accurate. Therefore, the default frequency is set to once per year The Q-factor is set to 4, because the data of Garcia-Hidalgo is quantitatively rich (n=723) and suits the scenario of consumer exposure.

11.3.1.1 Application: spraying polish on furniture

It is assumed that application of waxes and polishes to the surface of a floor is similar to that of a cupboard. The model and defaults in section 11.1.3.2 derived for floor spray polishes are therefore also used to estimate the exposures from furniture spray. Inhalation exposure to sprayed particles is estimated with the ***inhalation – exposure to spray – spraying release***. The dermal exposure is estimated with the ***dermal – direct product contact - constant rate loading*** (4.2.1). The defaults for the parameters mass generation rate, airborne fraction, density non-volatiles and contact rate area are in accordance with the generic scenario (4.2.1).

- Spray duration

The spray duration is calculated from the amount of product that needs to be applied to the surface. It is assumed that polish spray is just as effective as polish liquids, so that the respective required product amounts per m^2 are equal. The cupboard is 8 m^2 and the product amount of polish liquid per m^2 is 20-25 g (11.1.3.1.1), so that a product amount of 200 g spray polish is estimated. The mass generation rate of a furniture polish spray can is 1.8 g/s (see below). Hence, 111 s are needed to spray the entire cupboard. The default spray duration is thus set to 111 s. The Q-factor is 2, because the underpinning data is limited.

- Mass generation rate

Delmaar & Bremmer (2009) experimentally derived the mass generation for a spray can with furniture polish. They found a released amount of 18 g for spraying 10 s. Hence, the mass generation is set 1.8 g/s. The Q-factor is set to 3, because the data is specifically collected for furniture polish but is limited to 5 measurements on 2 samples.

- Initial Particle Distribution

Delmaar & Bremmer (2009) experimentally derived the particle size distribution of droplets released by spray can with furniture polish. They found a lognormal distribution with a median of 10.8 µm and a c.v. of 0.81. The default initial particle distribution is set accordingly. The Q-factor is set to 3, because the data is specifically collected for furniture polish but is limited to 5 measurements on 2 samples.

Table 11.21: Default values spraying furniture polish

	Default value	Q-factor	Source
General			
Frequency	1 per year	4	Garcia-Hidalgo et al., 2017
Inhalation - exposure to spray - spraying release			
Spray duration	111 s	2	See above
Exposure duration	90 min	1	Section 11.1.3
Room volume	20 m^3	3	Unspecified room (Te Biesebeek et al., 2014)
Room height	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate	0.6 per hour	4	Unspecified room (Te Biesebeek et al., 2014)
Mass generation rate	1.8 g/s	3	Delmaar & Bremmer, 2009

Airborne fraction	0.2	3	Section 4.2.1
Density non-volatile	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution			
Median (c.v.)	10.8 µm (0.81)	3	Delmaar & Bremmer, 2009
Inhalation cut-off diameter	15 µm	3	Delmaar & Schuur, 2016
Dermal - direct product contact- constant rate loading			
Contact rate			
Trigger sprays	46 mg/min	3	Section 4.2.1
Aerosol spray cans	100 mg/min	3	Section 4.2.1
Release duration	111 s	1	Spray duration

11.3.1.2 Application: polishing sprayed furniture

Additionally to the dermal exposure from deposition of sprayed aerosols to the skin of the consumer, dermal exposure by hand contact while rubbing the surface is expected. The ***dermal – direct product contact - instant application loading*** is used to estimate the dermal exposure via hand contact.

Product amount-dermal
It is assumed that the consumer accidentally touches the treated furniture with one hand palm (225 cm^2). In order to be conservative it is assumed that the entire amount product that is on the interface between surface of the furniture and that of the consumer's hand leads to dermal exposure. Hence, the amount per m^2 applied on the furniture is equal to the amount per m^2 on the palm of the hand of the consumer. For furniture polish spray the default product amount available for dermal exposure is thus calculated as (111 s x 1.8 g/s) / 8 m^2) x 225 cm^2 = 0.56 g. Q-factor is set to 1, because it is still conservative to assume that the product amount per m^2 on the treated surface is equal to the amount per m^2 on the exposed area.

Table 11.22: Default values for floor spray rubbing and polishing

	Default value	Q-factor	Source
General			
Frequency	1 per year	4	Garcia-Hidalgo et al., 2017
Dermal - direct product contact- instant application loading			
Exposed area	225 cm^2	3	Hand palm (Te Biesebeek et al., 2014)
Product amount	0.56 g	1	See above

11.3.2 *Liquid furniture polish*

Scenarios for consumer exposure
The consumer treats a large cupboard with a total area of 22 m^2 with undiluted liquid furniture polish in the living room. First, the product is sprinkled on a cloth and then it is rubbed upon the cupboard. Inhalation exposure is anticipated as volatile substances evaporate from the treated surface. Dermal exposure is expected due to spills and via hand contact while rubbing with a contaminate cloth. The treated surface is

not in reach of small children, so that secondary exposure is not expected.

11.3.2.1.1 Application: treating furniture with liquid polish

It is assumed that surface treatment with liquid furniture polish is comparable to surface treatment with liquid floor polish (11.1.3.1.). The molecular weight matrix is the exception here as it is product specific and differs from floor polishes. The scenario of inhalation exposure from treating a floor or furniture with liquid polish products agrees with the generic scenario for surface treatment (4.2.2.). Hence, to estimate the expected inhalation exposure the ***inhalation – exposure to vapour - evaporation - increasing release area*** is used. The scenario for dermal exposure however is not in agreement with the generic scenario, because the product is used in undiluted form and applied to the floor with a squeeze bottle. Here, the ***dermal – direct product contact - instant application loading*** is used (11.1.3.1).

- Molecular weight matrix

The most used liquid solvent in liquid furniture polish is turpentine (Table 11.20). Assuming that the other solvents have a molecular weight comparable to that of turpentine (136 g) the weight fraction of solvents in the product is characterized as 0.51 (Table 11.20). The molecular weight matrix of furniture polish is then calculated as 136 / 0.5 = 272 g/mol. The Q-factor is set to 1, because of the many and crude assumptions required to calculate the default.

Table 11.23: Defaults for the application of liquid furniture polish

	Default value	Q-factor	Source
General			
Frequency	1 per year	4	Garcia-Hidalgo et al., 2017
Inhalation - exposure to vapour- evaporation- increasing release model			
Exposure duration	90 min	2	Section 11.1.3.1
Product amount	550 g	2	Section 11.1.3.1
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	22 m^2	1	Scenario
Application duration	90 min	3	Section 11.1.3.1
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	272 g/mol	1	See above
Dermal - direct product contact - instant application loading			
Exposed area	450 cm^2	3	Hand (Te Biesebeek et al., 2014)
Product amount	1.1 g	1	Section 11.1.3.1

11.3.3 *Leather products*

Leather products are used to protect and clean leather surfaces in furniture and textile from stains. EPHECT (2012) show that just over one-third (35%) of the European population uses leather and textile coatings less than once a month, while 27% use them once or twice a month; 24% use them once or more a week, and 5% use them daily.

The products are mostly used in the living room (56%) and 45% is for use on leather furniture and interior decorations. The most often used formats for coating products are sprays (45%) and cream (33%).

Scenarios for consumer exposure
The consumer uses a spray can to treat a leather sofa (5.5 m^2) in the living room. Spray cans are ready-to-use products that are used undiluted. Exposure from mixing and loading is thus not to be considered (4.1.3). First, the product is sprayed upon the sofa. During spraying, inhalation exposure is anticipated as airborne droplets enter the breathing zone, whereas dermal exposure is expected from droplets depositing to the unprotected skin of the consumer. After spraying, the consumer leaves the furniture spray to dry and stays in the room for 4 hours. In case of volatile substances evaporation from the treated surface during the rubbing activity is not considered, because inhalation exposure to the volatile substance in spray is already covered in the instantaneous exposure estimate for the spraying activity (4.2.2.). Additional dermal exposure is also not expected, because the consumer is assumed not to sit on the sofa as long as it is still drying. The treated surface is not in reach of small children, so that secondary exposure is not expected.

- Frequency

Maintenance sprays are used 1 to 3 times a week according to AISE (2009). However, product information for maintenance of leather advices to spray the product every 2 to 3 months for intensive use part seats and elbow rests (HG, 2005). Based on the product information, the default is set at 5 per year. The Q-factor is 1, because the underpinning data from product information is limited.

11.3.3.1.1 Application: spraying leather maintenance spray

The scenario of spraying a sofa with leather maintenance spray agrees with the generic scenario for spray applications (4.2.1).The ***inhalation – exposure to spray – spraying release*** estimates the inhalation exposure and the ***dermal – direct product contact - constant rate*** estimates the dermal exposure.

- Mass generation rate

Leather maintenance sprays are available on the market as trigger sprays and aerosol spray cans. The respective generic mass generation rates 1.6 and 1.2 g/s. The default is thus set accordingly. The Q-factor is 3, because the underpinning quantitative data is generically collected for trigger sprays and aerosol spray cans and not specifically collected for leather maintenance sprays.

- Spray duration

Spray duration is calculated from the mass generation rate and the amount of leather maintenance spray is required to treat the sofa. According to product information a spray can of 300 (ml) can treat 10-15 m^2, whereas the density of a leather maintenance spray is 0.66 g/ml (HG, 2016). The amount of product required to treat a sofa of 5.5 m^2 is thus (5.5 m^2 / 10 m^2) x (300 ml x 0.66 g/ml) = 109 g. A trigger spray generates 1.6 g/s, so that the time required to spray 109 g is 68 s, for aerosol spray can this is 90 s. The default spray durations are set accordingly. The Q-factor is 2, because the underpinning data based on product information is limited.

- Release duration

Release duration, describing the duration the skin comes into contact with deposited aerosols, is interpreted as the intermittent spray duration, which is equal to the duration of the spraying task including breaks between sprays. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes release duration of 3 min assuming that half of the time the consumer is actually spraying and half of the time the consumer takes a break to prepare for spraying. The default for release duration remains 3 min. The Q-factor is 2, because the default partially depends on expert judgement and partially on sufficient quantitative data.

- Initial particle distribution

It is assumed that the particle size distribution of leather maintenance spray is comparable to that of furniture polish. As such, the default median particle diameter is set to 10.8 µm with a c.v. of 0.81 based on the report of Delmaar & Bremmer (2009). The Q-factor is set to 2, because the data referring the particle distribution comprises only one sample that was not leather maintenance spray.

Table 11.24: Default values spraying a sofa with leather product

	Default value	Q-factor	Source
General			
Frequency	5 per year	2	Product information
Inhalation -exposure to spray- spraying release			
Spray duration			
Trigger spray	68 s	3	See above
Aerosol spray can	90 s	3	See above
Exposure duration	240 min	1	Scenario
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Room height	2.5 m	3	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Mass generation rate			
Trigger spray	1.6 g/s	3	Section 4.2.1
Aerosol spray can	1.2 g/s	3	Section 4.2.1
Airborne fraction	0.2	3	Section 4.2.1
Density non-volatile	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution Median (c.v.)	10.8 µm (0.81)	2	Delmaar & Bremmer, 2009
Inhalation cut-off diameter	15 µm	3	Delmaar & Schuur, 2016
Dermal - direct product contact - constant rate loading			
Contact rate	100 mg/min	3	Section 4.2.1
Release duration	3 min	2	See above

12 Miscellaneous

Specific surfaces require special cleaning products. This chapter describes consumer exposure estimation to glass cleaners, oven cleaners, metal cleaners, drain openers, and shoe polish.

12.1 Glass cleaners

Glass cleaners loosen and dissolve oily marks from various glass surfaces such as windows, mirrors, glass cases and tables. Glass cleaners contain surfactants, solvents and alkalis that adhere to the glass surface and lift away dirt and grime. They clean the surface without leaving stripes and dry quickly. Mostly, they are applied undiluted with a trigger spray, but there are also glass cleaners available as liquids (mostly for cars), foams and wipes. Liquid cleaners and wipes are discussed already in Chapter 8. Below glass cleaner trigger sprays are discussed and suggestions are made to calculate consumer exposure to glass cleaner foams. The scenarios for modelling exposure when using a glass cleaner vary among the different use phases, because glass cleaner spray contains both volatile and non-volatile substances. Below only the exposure to non-volatiles are described.

Table 12.1: General composition of glass cleaners

Glass cleaners	Liquid spray[A] %
Surfactants	
Anionic	0-1
Non-ionic	0-1
Bases	0-5[B]
Ammonia	
Solvents	
Ethanol	5-20
Isopropyl alcohol	5-20
Additives	
Preservatives	<1
Fragrances	<1
colorants	0-0.2
Water	75-90

[A] www.cleanright.eu

The EPHECT survey (2012) shows that most people use glass and window cleaners once or twice a month (39%). Slightly fewer consumers use the product weekly (34%), and only 4% uses it on a daily basis. The cleaners are most often used in living rooms (79%), but also in bathrooms (71%), kitchens (70%) and bedrooms (67%).

Scenarios for consumer exposure

The consumer uses a trigger spray with glass cleaner to treat two glass tables (3 m^2) in the living room. Trigger sprays are ready-to-use products that are used undiluted. Exposure from mixing and loading is thus not to be considered (4.1.3). During spraying, inhalation exposure is anticipated as airborne droplets enter the breathing zone, whereas dermal exposure is expected from droplets depositing to the unprotected skin of the consumer. The consumer cleans the glass table with a dry cloth directly after a leave-on period of several minutes in which the glass cleaner is left on the surface to soak. In case of volatile substances evaporation from the treated surface during the leave-on is not considered, because inhalation exposure to the volatile substance in spray should be covered with the ***inhalation – exposure to spray – spraying release*** during the spraying activity (4.2.2.). Additional dermal exposure is expected during cleaning via hand contact with the surface that is cleaned. Finally, the glass cleaner is removed with the dry cloth, so that secondary exposure is not expected.

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 365 per year. AISE (2009) presents information for surface cleaners, but not specifically for glass surfaces. Analysis of the EPHECT data (Annex II) results in a 75th percentile of 66 per year for the use of glass spray cleaners. The summary data of Garcia-Hidalgo et al. (2017) only presents a frequency expressed in min/day and thus not applicable here. Based on the recent data of EPHECT and number of data points (n=981) the new default is set at 66 per year with a Q-factor of 4.

12.1.1 *Application: spraying glass cleaner*

Inhalation exposure to sprayed particles is estimated with the ***inhalation – exposure to spray – spraying release***. The dermal exposure is estimated with the ***dermal – direct product contact - constant rate loading*** (4.2.1). The defaults for the parameters mass generation rate, airborne fraction, density non-volatiles and contact rate area are in accordance with the generic scenario (4.2.1).

- Spray duration

Spray duration is interpreted here as the time in which the consumer is actually spraying, which is half the release duration. The release duration is interpreted as the intermittent spray duration, which is equal to the duration of the spraying task including breaks between sprays (see above). The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes that the actual spraying is intermitted half of the time. Hence, the default spray duration is calculated as half the release duration: 21 s. The Q-factor is 2, because the default partially depends on expert judgement and partially on sufficient quantitative data.

- Exposure duration

Exposure duration is interpreted here as the duration of the entire cleaning task. According to AISE (2014) the total task duration is between 2 and 10 minutes including spraying, soaking and cleaning duration. The default is set at 10 min with a Q-factor of 3.

- Mass generation rate

Glass cleaners are available as trigger sprays. The default mass generation is set according to the generic mass generation rate for trigger sprays which is 1.6 g/s (4.2.1). The Q-factor is 3, because the underpinning data is quantitatively sufficient but not specifically collected for glass cleaner sprays.

- Initial particle distribution

It is assumed that the particle size distribution of glass cleaner spray is comparable to that of all-purpose cleaner spray. As such, the default median particle diameter is set to 2.4 µm with a c.v. of 0.37 based on the report of Delmaar & Bremmer (2009). The Q-factor is set to 2, because the data referring the particle distribution comprises only one sample that was not glass cleaner spray.

- Release duration

Release duration here is interpreted as the intermittent spray duration, which is equal to the duration of the spraying task including breaks between sprays. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 0.7 min which is based on Weerdesteijn et al. (1997) 75th percentile 14.3 s per m^2. A glass surface of 3 m^2 thus takes 43 s to spray. The default is set at 42 s with a Q-factor of 3.

Table 12.2: Default values glass cleaner: spraying

	Default value	Q-factor	Source
General			
Frequency	66 per year	4	EPHECT, 2012
Inhalation -exposure to spray-spraying release model			
Spray duration	21 s	2	See above
Exposure duration	10 min	3	See above
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Room height	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Mass generation rate	1.6 g/s	3	Section 4.2.1.
Airborne fraction	0.2	2	Section 4.2.1
Density non-volatile	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution			
Median (c.v.)	2.4 µm (0.37)	3	See above
Inhalation cut-off diameter	15 µm	3	Section 4.2.1.
Dermal - direct product contact constant rate loading			
Contact rate	46 mg/min	3	Section 4.2.1
Release duration	43 s	3	See above

Note: Particles generated with foam sprays are too large to be inhaled; there is thus no inhalation exposure. It is assumed that dermal exposure equals the exposure calculated for trigger spraying.

12.1.2 *Application: cleaning surfaces with glass cleaner*

The consumer cleans the table with a dry cloth. Dermal exposure is estimated with the ***dermal - direct product contact - instant application loading***.

- Product amount -dermal

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a calculation for dermal exposure to undiluted products applied in surface treatment. It was assumed that 1% of the total amount that is applied ends up on the hand palms of the consumer. However, it is unclear whether this assumption is plausible for this specific scenario. Since, glass cleaner mainly consists of water (Table 12.1) it is assumed that the amount of product that ends up on the skin of the consumer can be calculated by multiplying the exposed area with a layer thickness of 0.01 cm (4.2.3). The exposed skin area is calculated as five phalanges (75 cm^2), because the rest of the hand is protected by the dry cloth. The amount of product on the fingers is then 75 cm^2 X 0.01 cm = 0.75 ml. The density of the product is estimated to be 1 g/ml, because it mainly consists of water. The default product amount that is available for exposure is thus set to 0.75 g.
Q-factor is set to 2, because the data underpinning the calculation is limited.

Table 12.3: Default values glass trigger spray cleaning

	Default value	Q-factor	Source
General			
Frequency	66 per year	4	Annex II
Dermal - direct product contact -instant application loading			
Exposed area Product amount	75 cm^2 0.75 g	3 2	Section 11.2.3.1 See above

12.2 Metal cleaners

Metal cleaners are developed to polish metal ware, remove marks and to restore shine for all kinds of metals such as chrome, copper, brass, aluminium and stainless steel. They make surfaces gleam and slow down the re-tarnishing process. There are two types of metal cleaners: water based products and solvent based products. Below the exposure to volatile substances in metal cleaners is discussed.

Table 12.4: General composition metal cleaners

Metal cleaners	Liquid Water based[A] %	Liquid Solvent based[A] %	Stainless Steel[B] %
Surfactants Anionic Non-ionic			 0-4 0-4
Solvents Naphtha	 31	 60-70	

Oleic acid Alkanolamine	0.5 0.2		
Bases or salts	0.5	2-3	
Additives Abrasives Phosphoric acid Polishing agents, e.g. quartz Water	 3.5 64	 9-12 	 0-6 10-20 75

A: cleanright.eu B: Prud'homme de Lodder et al., 2006a

Scenarios for consumer exposure
The consumer applies metal cleaner to a wet cloth and starts to clean a kitchen top of 2 m^2. The metal cleaner is used directly, so that exposure from mixing and loading is not considered (4.1.3). The kitchen top on which the product is applied is then wetted with a cloth, so that the product becomes diluted with water. The consumer then starts to polish the surface. Inhalation exposure is anticipated as volatile substances evaporate from the treated surface, whereas dermal exposure is anticipated via hand contact with the product. The consumer stays for one hour in the kitchen after the cleaning task.

- Frequency

By expert judgement it is assumed that a kitchen top is cleaned every two months with a metal cleaner (Prud'homme de Lodder et al., 2006a). The default is set at 6 per year. The Q-factor is 1, because the default depends on expert judgement only.

12.2.1 *Application: cleaning surfaces with metal cleaner*
The anticipated exposure to metal cleaners during surface treatment is estimated in accordance with the generic scenario for surface cleaning (4.2.2). Inhalation exposure to volatile substances is thus estimated with the ***inhalation - exposure to vapour -evaporation – increasing release*** and dermal exposure is estimated with the ***direct product contact -instant application loading.***

- Product amount -inhalation

The product amount that is available for inhalation is interpreted here as the amount that is applied on the kitchen top. The product is used diluted, so that the product amount is calculated from the volume of water on the kitchen top and the concentration of metal cleaner in the water. Product information recommends a mixture of water and metal cleaner in a ratio 1:1 (Swissvax, 2016). Hence, it is assumed that wetting the kitchen top results in mixture that comprises 0.5 ml water and 0.5 ml metal cleaner. Metal cleaners are either naphtha (1.14 g/ml) or water based (1 g/ml) based. The concentration of metal cleaner in the mixture is thus calculated as 1.14 g/ml x 0.5 = 0.57 g/ml for naphtha based metal cleaners and for water based the concentration is 1 g/ml x 0.5 = 0.5 g/ml. Based on a small experiment (Prud'homme de Lodder et al., 2006a), it is assumed that a wet surface comprises 40 ml liquid per m^2. The volume of the mixture on a wet kitchen working top of 2 m^2 is thus estimated to be 80 ml. The product amount applied on the kitchen top is thus 0.57 g/ml x 80 ml = 46 g for naphtha based metal cleaners and 0.5 g/ml x 80 ml =40 g for water based metal cleaners. The default product amounts available for inhalation is set to

46 g and 40 g for naphtha and water based metal cleaner respectively. The Q-factor is set to 2, because the underpinning data is limited.

- Dilution factor

The dilution factor refers to the ratio of the product amount and the total mass of the substance in which it is diluted (4.2.3). Here, the factor is equal to the product concentration in the water that is applied on the kitchen top in kg product per kg water. Hence, the dilution factors are equal to 0.57 for naptha based and 0.5 for water based metal cleaner. The Q-factors are set to 2, because the calculation is not entirely based on expert judgement but lacks underpinning with quantitative data.

- Product amount -dermal

The product amount that is available for dermal exposure is interpreted here as the amount that ends up on the hand of the consumer from touching the wet cloth. According to the generic scenario for surface treatment with a wet cloth (4.2.2) the dermal product amount for naphtha based metal cleaners is calculated as (46 g / 2 m^2) x (2.25 ml /40 ml) = 1.3 g and for water based cleaner (40 g /2 m^2) x (2.25 ml /40 ml) = 1.1 g.

- Application duration

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 10 min based on expert judgement only. AISE (2014) presents a maximal task duration for cleaning surfaces with gel products of 20 minutes, which is also used as the default application duration for cleaning a kitchen top with abrasive liquids (9.2.1). The task of polishing a kitchen top with abrasive liquid is comparable to the task of polishing a kitchen top with metal cleaner. Therefore, the default is set to 20 min. The Q-factor is set to 3, because the underpinning data is generic for polishing surfaces and not specifically collected for polishing a kitchen top with metal cleaner.

- Molecular weight matrix

The matrix from which substance evaporates is interpreted here as the mixture that is applied on the kitchen top. The fraction of water in the mixture is calculated to range between 0.8 and 0.9 for water based metal cleaners, since they consist of 25-36% other substances that are diluted in a ratio of 1:1. The default molecular weight matrix for water based metal cleaners is thus calculated as 18 g/mol divided by 0.9 = 20 g/mol.
The actual fraction of naphtha, which has a molecular weight of 128 g /mol, in naphtha, based metal cleaners ranges between 0.6 and 0.7 (Table 12.4). This fraction is diluted in the mixture to 0.3-0.35. The weight fraction of water in the naphtha mixture is 0.47, because 1.07 g mixture comprises 0.57 g metal cleaner and 0.5 g water (0.5 g/1.07 g =0.47). The default molecular weight matrix of naphtha based metal cleaners is then calculated as: 1/ (0.47/18 + 0.3/128) = 35 g/mol. The Q-factors are set to 2, because the underpinning data is limited.

Table 12.5: Default values metal cleaners

	Default value	Q-factor	Source
General			
Frequency	6 per year	2	Product information
Inhalation -exposure to vapour-evaporation- release area model			
Exposure duration	60 min	3	Scenario
Product amount			
Water based metal cleaner	40 g	2	See above
Naphtha based metal cleaner	46 g	2	See above
Dilution factor			
Water based metal cleaner	0.5	2	See above
Naphtha based metal	0.57	2	Kitchen
Room volume	15 m^3	4	(Te Biesebeek et al., 2014) Kitchen
Ventilation rate	2.5 per hour	3	(Te Biesebeek et al., 2014)
Release area	2 m^2	3	Section 9.1
Application duration	20 min	2	Section 9.1
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix			
Water based metal cleaner	20 g/mol	2	See above
Naphtha based metal cleaner	35 g/mol	2	See above
Dermal Exposure- instant application model			
Exposed area	225 cm^2	3	Inside hand
Product amount			(Te Biesebeek et al., 2014)
Water based metal cleaner	1.1 g	2	See above
Naphtha based metal cleaner	1.3 g	2	See above

12.3 Drain openers

Drain openers unclog and help prevent clogging in kitchen sinks, toilets and bathroom drains by dissolving and loosening grease and organic waste. Drain openers are available in liquid and solid form. They can be based on hypochlorite in combination with sodium or potassium hydroxide, sulphuric acid, or biological enzyme- and bacteria-based. Chemical drain openers are corrosive.

Aided by the heat of hot water drain openers chemically break down fats, hair and other deposits. Usually they are added undiluted into drains. Drain openers containing bacteria or enzymes clear the drains by breaking down the organic material first into small, simple pieces and afterwards into the two basic components carbon dioxide and water. Biological drain openers are not discussed in this Fact Sheet. Below the exposure to volatiles is discussed.

Table 12.6: General composition of drain openers

Drain openers	Sulphuric Liquid[A] %	Water Based Liquid[B] %	Solid[A] %
Alkaline			
Sodium or potassium hydroxide		20-40	100
Acid			
Sulphuric acid	98		
Surfactants		1-2	
Viscosity controlling agents		0-1	
Bleach		0-5	
Aluminium			<1
Water	<2	60-80	

A: Prud'homme de Lodder et al., 2006a;
B: www.cleanright.eu
Note: Hands and eyes should be protected since drain openers contain corrosive substances. However, it is assumed that not all consumers will follow the instructions, so that no gloves and glasses are used while cleaning.

Scenarios for consumer exposure
Drain openers are available on the market as granules and liquids. They are ready-to-use products that are poured directly into the sink that is to be treated. Exposure from mixing and loading is thus not considered (4.1.3). Instead, dermal exposure is expected while pouring the granules or liquids to spilled droplets ending up on the consumer's hands. Inhalation exposure is anticipated as well as volatile substances evaporate from the flask into the breathing zone of the consumer. Once the drain opener is down the drain, it is left there to soak for several minutes. It is assumed that 0.25 l water is added to the granule drain opener in order to dissolve the granules. Inhalation exposure is expected during this period of leave-on from volatile substances that evaporate out of the drain. After leave-on, the product is flushed away with an abundant volume of water flowing out of the tap.

- Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default for use frequency of 4 per year, which is based on Versar (1992) reporting a 75th percentile of 2 times per 6 months. According to AISE (2014) the maximum frequency is once a week (typically less than once a week). According to the scenario the drain opener is used in case the drain is clogged. Product information recommends a use of 2 times a month to avoid unpleasant odours (HG, 2016), which agrees with the typical frequency reported by AISE. Therefore, the frequency reported by AISE is select to represent the default frequency of 24 per year. The Q-factor is 2, because the underpinning data is limited.

12.3.1 *Application: pouring drain opener down the drain*

Dermal exposure from pouring the liquid or granules is estimated with the ***dermal - direct product contact - constant rate loading*** (4.1.1). Inhalation exposure from volatile substances evaporating out of the flask upon pouring is estimated with *the* ***inhalation - exposure to vapour - evaporation***.

- Molecular weight matrix

The molecular weight matrix depends on the composition of the drain opener. Liquid drain openers are either water based or acid based. The acid based drain openers comprise a fraction of 0.98 sulphuric acids, which has a molecular weight of 98 g/mol. Hence, the default molecular weight matrix for acid based drain openers is set to 98 g/mol.
The water based liquid drain opener comprises a fraction of 0.2-0.4 sodium, which has a molecular weight of 23 g/mol, and a fraction of 0.6-0.8 water. The default molecular weight matrix for water based drain openers is thus calculated as 1/(0.8/18 +0.2/23) = 19 g/mol.
Granule drain fully consist of sodium, so that the molecular weight is 23 g/mol.

Table 12.7: Defaults for pouring drain opener into the sink

	Default value	Q-factor	Source
General			
Frequency	24 per year	2	AISE, 2014
Inhalation - exposure to vapour- evaporation			
Exposure duration	0.75 min	3	Section 4.1.2
Product amount	500 g	3	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	0.5 per hour	1	Section 4.1.2
Release area	20 cm^2	2	Section 4.1.2
Application duration	0.3 min	3	Section 4.1.2
Temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix			
Sulphuric acid	98 g/mol	2	See above
Water based drain opener	19 g/mol	2	See above
Granule drain opener	23 g/mol	2	See above
Dermal - direct product contact - instant application loading			
Exposed area	225 cm^2	3	Section 4.1.2
Product amount			
Sulphuric acid	0.01 g	2	Section 4.1.2
Water based drain opener	0.01 g	2	Section 4.1.2
Granule drain opener	1.25 mg	2	Section 4.1.2

12.3.2 *Application: leaving drain opener to soak*

The ***inhalation - exposure to vapour- evaporation*** is used to estimate inhalation exposure to volatile substances evaporating from the drain.

- Temperature

Hot water is added to the granule drain openers. It is assumed that the consumer uses a water boiler to heat the water, but the water is cooled to a temperature of 95°C once it is poured into the drain. The Q-factor is set to 2.

- Molecular weight matrix

The molecular weight of granule drain openers is altered once the hot water is added. The product amount of 500 g is diluted with 250 g hot water. The weight fraction of granules in the mixture is thus 500 g/ (250 g +500 g) =0.67 and the weight fraction of water in the mixture is 250 g / (250 g + 500 g) = 0.33. The default molecular weight matrix for granule drain openers is calculated as 1/ (0.67/23 +0.33/18) = 21 g/mol. The Q-factor is set to 2, because the underpinning data is limited.

- Product amount

The product amount that is available for inhalation is interpreted here as the amount that poured into the drain. For granules the default product amount is set to 70 g per task (AISE 2014). Product information recommends a use of 300 ml for liquid drain openers (HG, 2016). Hence, the default product amount for water based drain openers is 300 g. The density of sulphuric acid is 1.84 g/ml, so that the default product amount is calculated as 300 ml x 1.84 g/ml = 550 g. The Q-factors are set to 2, because the underpinning data is limited.

- Application duration

The application duration is interpreted here as the duration for the drain opener to soak. According to AISE (2014) the typical duration of soaking a drain is 10 minutes (range 5-15 minutes). Product information however recommends a soaking period of 30 min for liquid drain openers (HG, 2016). The default is set at 15 min for granules and 30 min for liquid drain openers. The Q-factor is set to 2, because the soaking periods strongly depend on the clog that needs to be dissolved. For example, heavy clogs in kitchen sinks require a soaking period of 6-8 hours (HG, 2016).

- Exposure duration

The exposure duration is set equal to the application duration, because the drain opener is flushed away after the soaking period.

Table 12.8: Defaults for application of drain opener in a sink

	Default value	Q-factor	Source
General			
Frequency	24 per year	2	AISE, 2014
Inhalation - exposure to vapour- evaporation			
Exposure duration			
Sulphuric acid	30 min	2	See above
Water based drain opener	30 min	2	See above
Granule drain opener	15 min	2	See above
Product amount			
Sulphuric acid	550 g	2	See above
Water based drain opener	300 g	2	Product information
Granule drain opener	70 g	2	AISE, 2014
Room volume	20 m^3	3	Unspecified room (Te Biesebeek et al., 2014)
Ventilation rate	0.6 per hour	3	Unspecified room (Te Biesebeek et al., 2014)
Release area	20 cm^2	1	Drain
Application duration			
Sulphuric acid	30 min	2	Product information
Water based drain opener	30 min	2	Product information
Granule drain opener	15 min	2	AISE, 2014
Temperature			
Sulphuric acid	20 °C	4	Room temperature
Water based drain opener	20 °C	4	Room temperature
Granule drain opener	95 °C	2	See above
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix			
Sulphuric acid	98 g/mol	2	Table 12.7
Water based drain opener	19 g/mol	2	Table 12.7
Granule drain opener	21 g/mol	2	See above

12.4 Shoe polish products

Shoe polish products are available as polishes, sprays (chapter 11.5.1), wipes and instant-shine liquids and creams (chapter 11.5.2). The ingredients are for protecting and nourishing different types of shoes, for example leather, suede or nubuck. Below the exposure to non-volatiles is considered.

Table 12.9: General composition of shoe polish products

Shoe polishers	Polish[A,B] %
Waxes and paraffin's	20-40
Solvents	>50
Additives Dye Propellants Water	 0.1-0.3 <18[A*] +

A: Prud'homme de Lodder et al., 2006a
B: www.cleanright.eu

The EPHECT survey data (2012) show for leather and textile coatings that just over one-third of the respondents (35%) use the product less than once a month, while 27% use them once or twice a month, 24% use them once or more a week, and 5% use them daily. The products are mostly used in the living room (56%) and 15% in other room in the house. The products are most often used on leather accessories such as shoes and handbags (52%). The most often used formats for coating products are sprays (45%) and cream by 33% of the respondents. Furthermore, the EPHECT data (2012) show for leather and textile product that the favourite surface is that of leather clothing accessories (including shoes) and for 26% textile accessories (including shoes).

12.4.1 *Shoe polish spray*

Scenarios for consumer exposure
Polish sprays are ready-to-use products, so that exposure during mixing and loading is not relevant (4.1.3). According to their product information shoes must be sprayed with several light coatings from a distance of minimal 20 cm. It is assumed that the user sprays 4 pair of shoes in the garage with several light coatings, such as damps. Furthermore it is assumed the consumer does not rub over the shoe with a cloth to quicken the drying up. Moreover, between each application the shoe polish dry as well. The shoes are also not polished up at the end. Inhalation exposure estimation can be performed with the ***inhalation – exposure to spray – spraying release*** and the ***dermal – direct product contact - instant application*** estimates the dermal exposure.

- Frequency

Prud'homme de Lodder et al. (2006a) uses a default of 8 per year, based on 75th percentile from Westat (1987). The EPHECT survey (2012) shows that 56% of their respondents use leather and textile products at least once a month. According to AISE (2014) maintenance products for furniture, shoes and leather are used 1 to 3 times per week (typically once a week). From the summary data of Garcia-Hidalgo et al. (2017) it is derived that the respondent representing the 75th percentile would declare to use shoe care products "every month". Hence, the data of Garcia-Hidalgo is preferred over that of AISE and EPHECT, because it specifically collected for shoe care products and does not refer to other leather products as well. The default frequency is therefore set to 12 per year. The Q-factor is set to 4, because the underpinning data is both quantitatively rich and specifically collected for shoe care products.

12.4.1.1 Application: spraying shoe polish

- Spray duration

Spray duration is calculated from the amount of product required to treat the shoes and the mass generation rate of the spray. The generic mass generation rate of aerosol spray cans is 1.2 g/s (4.2.1), whereas the mass generation rate of water-repellent making products is experimentally determined to be 0.6 g/s (Tuinman 2004, 2007). AISE (2014) gives a typical amount of 30 g per task (range between 2 and 60 g) for maintenance sprays in general. The specific product amount required to polish shoes however is unclear. Product information for oil, grease, water and grime repellents for leather objects such as prescribe a treatment of 58 g per m^2 (HG, 2008). According to the General Factsheet, the default surface area of one adult foot is 0.06 m^2 (Te Biesebeek et al., 2014). It can thus be calculated that one shoe requires 3.4 g (0.06 m^2X 58 g/m^2 =3.4 g) of leather maintenance product, assuming that the surface area of an adult foot is representative for a shoe. According to the scenario, the consumer treats four pairs of shoes, so that 27 g of product amount is used in total. The spray duration is then calculated to be 46 s (27 g / 0.6 g/s =46 s) assuming that the mass generation rate of furniture polish is representative for that of shoe polish sprays. The Q-Factor is set to 1, because the data underpinning the calculation is limited and the calculation is based on a number of assumptions.

- Exposure duration

It is assumed that the consumer remains in a garage for several minutes. Prud'homme de Lodder et al. (2006a) uses a default of 5 min and AISE (2014) reports minimum task durations of 5 min for maintenance. The duration default remains at 5 min with a Q-factor of 2.

- Mass generation rate

It is assumed that the mass generation of furniture polish is also representative for shoe polish sprays. Based on the experimental data of Delmaar & Bremmer (2009), the default mass generation is set to 1.8 g/s. The Q-factor is 2, because the data is quantitatively poor and does not directly refer to shoe polish sprays.

- Airborne fraction

Shoe polish is sprayed towards a surface. The data of Delmaar & Bremmer (2009) show the airborne fraction for sprays used towards surfaces is 0.3 at highest. The default airborne fraction is set to 0.3. The Q-factor is 2, because the underpinning data is quantitatively poor and not specifically collected for shoe polish sprays.

- Initial particle distribution

It is assumed that the particle size distribution of furniture polish is also representative for shoe polish sprays. As such, the default median particle diameter is set to 10.8 µm with a c.v. of 0.81 based on the report of Delmaar & Bremmer (2009). The Q-factor is set to 2, because the data referring the particle distribution comprises only one sample that was not shoe polish spray.

- Product amount -dermal

Prud'homme de Lodder et al. (2006a) prescribes a contact rate model. This prescription however is considered not applicable, because airspace spraying does not account for spraying towards the user. During spraying the consumer holds up the shoe with one hand, thus the spray is also directed to the hand holding the shoe. Bremmer et al. (2006a) provides a default for dermal exposure due to spraying with hair spray. Bremmer et al., assumed that 90% of the spray ends up on the head (hair + skin), whereas 10% misses the hair and ends op on the scalp. Adopting a similar approach for spraying towards a hand holding a shoe yields a product amount available for dermal exposure of 2.7 g. The new default is thus set to 2.7 g. The Q-factor is set to 1, because of the crude assumptions in the calculation.

Table 12.10: Default values shoe polish spray

	Default value	Q-factor	Source
General			
Frequency	12 per year	4	Garcia-Hidalgo et al., 2017
Inhalation: exposure to spray- spraying release			
Spray duration	46 s	2	See above
Exposure duration	5 min	2	See above
Room volume	34 m^3	3	Garage (Te Biesebeek et al., 2014)
Room height	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate	1.5 per hour	3	Garage (Te Biesebeek et al., 2014)
Mass generation rate	1.8 g/s	2	See above
Airborne fraction	0.3		Delmaar & Bremmer, 2009
Initial particle distribution			
Median (c.v.)	10.8 μm (0.81)	2	See above
Inhalation cut-off diameter	15 μm	3	Delmaar & Schuur, 2016
Dermal: direct product contact -instant application loading			
Exposed area	450 cm^2	3	Full Hand (Te Biesebeek et al., 2014)
Product amount	2.7 g	1	See above

12.4.2 *Shoe polish cream*

Scenarios for consumer exposure
Shoe polish cream is considered to be a ready-to-use product, so that consumer exposure during mixing and loading is not considered to be relevant (4.1.3).The consumer directly applies the shoe polish cream with an application brush or soft cloth to 4 pair of shoes. After drying, the shoes are brushed and polished up with a shine cloth.

- Frequency

Prud'homme de Lodder et al. (2006a) set the default based on use 90th percentile frequency polish spray from Westat (1987). The EPHECT survey data (2012) shows that 56% of their respondent population uses leather and textile products at least once a month. From the summary data of Garcia-Hidalgo et al. (2017) it is derived that the respondent representing the 75th percentile would declare to use shoe care products "every month". Hence, the data of Garcia-Hidalgo et al. (2017) is consistent with that of EPHECT (2012). Moreover, the data of Garcia-Hidalgo et al. (2017) is specifically collected for shoe care products and does not refer to other leather products as well. The default frequency is therefore set to 12 per year. The Q-factor is set to 4, because the underpinning data is both quantitatively rich and specifically collected for shoe care products.

12.4.2.1 Application: polishing shoes with cream

The ***dermal - direct product contact - instant application loading*** is used to estimate the dermal exposure for polishing shoes with cream (4.2.4)

- Product amount -dermal

Product information for oil, grease, water and grime repellents for leather objects such as prescribe a treatment of 58 g per m^2 (HG,2008). According to the General Factsheet, the default surface area of one adult foot is 0.06 m^2 (Te Biesebeek et al., 2014). It is assumed that the amount of product per m^2 that ends up on the skin of the consumer is equal to the amount of product per m^2 applied on the shoes. The exposed area is considered to be that of one hand palm, which is according to the General Fact Sheet 225 cm^2. Hence, the product amount available for dermal exposure is calculated to be 225 cm^2 x 58 g/m^2 = 1.3 g. The Q-factor is set to 1, because the calculation is based on crude assumptions.

Table 12.11 Default values shoe cream

	Default value	Q-factor	Source
General			
Frequency	12 per year	4	Garcia-Hidalgo et al., 2017; EPHECT ,2012
Dermal -direct product contact - instant application loading			
Exposed area	225 cm^2	3	Inside hand (Te Biesebeek et al., 2014)
Product amount	1.3 g	1	See above

12.5 Oven cleaners

Oven cleaners are strong degreasers and usually contain strong alkali and solvents to break down burnt-on fats and other deposits. They are available as liquid and spray (trigger or foam) formulation, so that inaccessible places can be reached. Liquid cleaners and wipes are discussed in chapter 6.2 and chapter 6.3, respectively. Below the trigger sprays are discussed and suggestions are made for the use of foam (sprays).

Oven cleaners contain surfactants, solvents and additives. The scenarios for modelling consumer exposure when using oven spray cleaners vary among the different use phases, because the spray contains both volatile and non-volatile substances.

Table 12.12: General composition oven cleaners

Oven cleaners	Liquid[A] %	Aerosol[A] %	General[B]
Surfactants Anionic and non-ionic surfactants	0-10	0-10	1-5
Solvents	0-10	0-10	0-33
Additives Monoethanolamine Potassium carbonate Sodium metasilicate	 0-5 0-10 0-5	 0-5 0-10 0-5	 1-5

Sodium hydroxide	0-0.5	0-0.5	1-5
Aluminium oxide			25-50
Propellants		10-20	1-5
Wax			20-50
Fragrance			1-5
Water	Up to 100	Up to 100	Up to 100

A: www.cleanright.eu
B: Danish EPA, 2010

Exposure to oven and cooktop cleaners mainly occurs via skin contact when using liquid, cream, and/gel products, and via inhalation when using spray products. Some oven cleaners are used at very high oven temperatures, which results in increased evaporation and thus increased risk of inhalation, e.g. for bases and solvents. As oven cleansing will mostly require thorough cleaning, oven cleaners are potentially more hazardous to human health compared to other cleaning products (Danish EPA 2010). Oven cleaners that work in a cold oven are even stronger than those designed to work in a heated oven (cleaninginsitute.org). Note that although product information recommends to wear rubber gloves and to avoid contact with skin and eyes, not all consumers will follow the instructions. Given the aggressive nature of oven cleaners, it is unlikely that consumers do not protect themselves. However, it is assumed nonetheless that no gloves are worn while cleaning. EPHECT (2012) reports kitchen cleaners as products used for cleaning and/or degreasing different surfaces in the kitchen, i.e. oven cleaners, water softeners, stainless steel cleaners etc. Kitchen cleaners are mostly used on sinks (71%) and electrical kitchen appliances (70%). Almost half of the consumers use special oven cleaners (48%).

Scenarios for consumer exposure
Trigger spray oven cleaners are ready-to-use products, so that consumer exposure during mixing and loading is not considered relevant (4.1.3). The consumer sprays the oven cleaner spray/foam directly into cleans a cold oven with dimensions of 20 x 40 x 45 cm. After spraying the oven door is closed and the product has to soak. During this phase the dirt and grime is soaked to enable an easy and better cleaning. During the soaking there is no inhalation exposure because the oven is closed. The bulk of the particles will then be inside the oven space. Here they will deposit so that they are no longer be airborne after the soaking-phase. Hence, the momentum of inhalation exposure will be during the spraying phase. Dermal exposure during spraying is considered as well, because the consumer sprays within a confined space. According to the Danish EPA (2010) for products in aerosol cans with a propellant 60% of the product stays in the air and 10% of this amount contacts the skin. Next the oven needs to be wiped clean with a wet cloth of sponge, so that dermal contact with the oven is expected occur again.

- Frequency

Prud'homme de Lodder et al. (2006a) uses a default of 25 per year. The Danish EPA (2010) assumes that the product is used once a week for cleaning the oven as an expression of a worst-case approach. Analysis of the EPHECT data shows a 75th percentile for the use frequency of kitchen spray cleaners is 190 per year and 99 per year for kitchen cleaner foam. Based on the summary data of Garcia-Hidalgo et al. (2017) it is derived that the respondent representing the 75th percentile would declare to use oven cleaner 2-5 times per year. The data of Garcia-Hidalgo et al. (2017) is preferred over the worst case expression and the EPHECT data, because it is quantitatively rich and specifically collected for oven cleaners. The default frequency is therefore set to 5 per year with a Q-factor of 4.

12.5.1 *Application: spraying oven cleaner*

The substances considered as exposure during the spraying phase are considered to be (associated with) the sprayed non-volatile aerosol particles. The ***inhalation – exposure to spray – spraying release*** *mode* is used to estimate the inhalation (4.2.1) and the ***dermal – direct product contact - instant application*** estimates the dermal exposure.

- Spray duration

The spray duration is calculated by dividing the amount of product used with the mass generation of the oven cleaner spray. Prud'homme de Lodder et al. (2006a) on a sprayed amount of 24 g. This 24 g was derived as twice the maximum amount of product used in an observation study performed Weerdesteijn et al. (1999) where persons where asked to clean a surface with a spray. The 75th percentiles derived from the EPHECT (2012) data for kitchen sprays are 11 g for foam and 6.1 g for trigger spray. Danish EPA (2010) describes a product amount of 8 g in an exposure assessment to substances in oven cleaner, but the motivation for this value is not made explicit. Straightforward and explicit data for characterizing the amount of oven cleaner product used is thus not available. In lack of such data it is assumed that 12 g of product is used on order to be consistent with the EPHECT (2012) data for kitchen spray (that also includes oven spray) and the maximum amount found by Weerdesteijn et al., 1999). According to previous Cleaning Product Fact Sheet (Prud'homme de Lodder et al., 2006a) the mass generation of an oven spray cleaner is 0.8 g/s. However, this mass generation rate actually refers to the intermittent spray duration divided by the sprayed amount in the observation studies of Weerdesteijn et al. (1999). Therefore, the generic mass generation for trigger sprays (1.6 g/s) and aerosol spray cans (1.2 g/s) are used for calculating the spray duration. A product amount of 12 g dived by these mass generation rates yield spray durations of 7.5 s and 10 s respectively. The defaults are set accordingly with a Q-factor of 1 to account for lack of data in the used product amount and mass generation rate.

- Exposure duration

Prud'homme de Lodder et al. (2006a) describes a default exposure duration of 60 min, which is based on inhalation in a kitchen as location. General consumer practise however would be to close the oven after finishing spraying. In that case the exposure duration can be derived as the intermittent spray duration which is already mentioned above. According to Weerdesteijn et al. (1999), intermittent spraying of oven cleaner yields 0.8 g/s. The exposure duration for a product amount of 12 g is then calculated to be 15 s. The Q-factor is set to 1, because the underpinning data is limited and the calculation does not discriminate between trigger sprays and aerosol spray cans.

- Room volume

Spraying inside an oven is within the breathing zone the breathing zone of the consumer holding the spray can. The room volume is therefore set to the default of 1 m^3 (4.2.1) with a Q-factor of 1.

- Room height

Room height refers here to the height the oven which is 0.2 m according to the oven specifications described in the scenario.

- Room ventilation

The oven is assumed to be located in the kitchen. The default ventilation rate for kitchen is set to 2.5 per hour in accordance with the General Fact Sheet with a Q-factor of 3 (Te Biesebeek et al., 2014).

- Initial particle distribution

Since the publication of the previous Cleaning Product Fact Sheet (Prud'homme de Lodder et al., 2006a), there has not become more suitable data available that describes the particle size distribution of oven cleaners. Therefore the old default maintains: a median particle size of 100 µm with a c.v. of 0.6. The Q-factor is set to 1, because the data is generically collected for large particulates and not specifically collected for oven cleaning sprays. Moreover, the default does not discriminate between aerosol spray cans and trigger sprays.

- Product amount -dermal

In this specific situation the consumers sprays into an oven, which is a confined space leading to additional dermal exposure. According to the Danish EPA (2010) this could be to 6% of the sprayed amount (0.66 g). The new default is thus set to 0.7 g. The Q-factor is set to 1, because the default is originally derived from expert judgement.

Table 12.13: Default values oven trigger spray (foam): spraying

	Default value	Q-factor	Source
General			
Frequency	5 per year	4	Garcia-Hidalgo et al., 2017
Inhalation - exposure to spray -spraying release			
Spray duration			
Trigger spray	7.5 s	1	See above
Aerosol spray can	10 s	1	See above
Exposure duration	15 s	1	See above
Room volume	1 m^3	1	Section 4.2.1
Room height	0.2 m	1	Oven height, see above
Ventilation rate	2.5 per hour	3	Kitchen (Te Biesebeek et al., 2014)
Mass generation rate	1.6 g/s	3	
Trigger spray	1.2 g/s	3	Section 4.2.1.
Aerosol spray can	0.2	2	Section 4.2.1.
Airborne fraction			Section 4.2.1
Initial particle distribution	100 µm (0.6)	1	Prud'homme de Lodder et al., 2006a

Median (c.v.) Inhalation cut-off diameter	15 µm	3	Delmaar & Schuur, 2016
Dermal exposure -instant application			
Exposed area Product amount	450 cm^2 0.7 g	3 2	Hand (Te Biesebeek et al., 2014) Danish EPA, 2010

12.5.2 *Application: cleaning the oven*

When cleaning, the user wipes of the oven cleaner with a towel. The dermal exposure to non-volatiles is estimated with the ***dermal – direct product contact - instant application loading*** (4.2.2.).

- Product amount -dermal

Prud'homme de Lodder et al. (2006a) uses 0.2 g as default (as a fraction of an amount used of 24 g). During the spray-phase 11 g is the product amount generated (EPHECT, 2012). The oven is cleaned with a wet cloth. According to the dimensions of the oven, the surface that needs to be cleaned is 0.7 m^2. In a small experiment it was observed that a surface is fully wet at 40 ml water per m^2, so that the volume of water needed to clean the oven is 28 ml. The concentration of oven cleaner in the water is then 11 g /28ml = 0.4 g/ml. The volume of water that is in contact with the skin from touching the wet cloth is 2.25 ml (see Section 4.2.2), so that the product amount that is available for dermal exposure is calculated to be 2.25 ml X 0.4 g/ml = 0.9 g. The default product amount available for dermal exposure is thus set to 0.9 g. The Q-factor is set to 2, because the underpinning data is limited.

Table 12.14: Default values oven trigger spray (foam): cleaning

	Default value	Q-factor	Source
General			
Frequency	5 per year	4	Garcia-Hidalgo et al., 2017
Dermal - direct product contact - instant application loading			
Exposed area Product amount	225 cm^2 0.9 g	3 1	Inside hand (Te Biesebeek et al., 2014) See above

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Annex I Default data Table Cleaning Products Fact Sheet 2017 and 2006

All Cleaning Products Fact Sheet data for exposure scenarios, selected ConsExpo models and default parameter values reported in the current Fact Sheet and that of 2006 are presented in one table below (Table A1). Alterations compared to 2006 are marked yellow.

Table A1: All Cleaning Products Fact Sheet data for exposure scenarios, selected ConsExpo models and default parameter values published in 2006 and 2017

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017			Cleaning Products Fact Sheet 2006		
			Default Value	Unit	Q-factor	Default Value	Unit	Q-Factor
Loading machine wash powders (6.1.1- 3.1.1)	General	Frequency	365	per year	4	365	per year	3
	Inhalation- exposure to spray- instantaneous release*1	Exposure duration	0.25	min	3	0.25	min	3
		Product amount - Regular Powder	6.2	µg	1	0.27	µg	1
		Product amount - Compact Powder	3.1	µg	1	Not Included In FS 2006		
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	2	per hour	3	2	per hour	1
	Dermal-direct product contact- constant rate loading	Contact rate	5	mg/ min	3	Not Included In FS 2006		
		Release duration	0.25	min	3			
		Exposed area	225	cm^2	3			
Loading machine wash liquids (6.1.2- 3.2.1)	General	Frequency	365	per year	4	365	per year	3
	Inhalation- exposure to vapour - evaporation	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	3	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	2	per hour	1	2	per hour	1
		Release area	20	cm^2	2	20	cm^2	2
		Application duration	0.3	min	3	0.3	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer rate	10	m/h	3	Lang muir	m/h	X
		Molecular weight matrix	90	g/m ol	2	90	g/mol	2
	Dermal-direct product contact- instant	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.01	g	3	0.01	g	3

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
	application loading model							
Hanging machine washed laundry (6.1.3)	General	Frequency	365	per year	4	Not included in FS 2006		
	Inhalation- exposure to vapour- evaporation - increasing release area	Exposure duration	20	min	1			
		Product amount- Regular powder	3.8	g	2			
		Product amount- Compact Powder	1.9	g	2			
		Product amount- Regular liquid	3.8	g	2			
		Product amount- Compact liquid	2.3	g	2			
		Product amount- Tablet	1.9	g	2			
		Product amount- Capsule	2.3	g	2			
		Dilution factor- Regular Powder	0.00 076	(-)	2			
		Dilution factor- Compact Powder	0.00 038	(-)	2			
		Dilution factor- Regular Liquid	0.00 076	(-)	2			
		Dilution factor- Compact Liquid	0.00 046	(-)	2			
		Dilution Factor- Tablet	0.00 038	(-)	2			
		Dilution Factor- Capsule	0.00 046	(-)	2			
		Room volume	20	m^3	3			
		Ventilation rate	0.6	per hour	3			
		Release area	10	m^2	2			
		Application duration	15	min	1			
		Temperature	20	°C	4			
		Mass transfer rate	10	m/h	3			
		Molecular weight matrix	18	g/m ol	4			
	Dermal- direct product contact - instant application loading	Exposed area	900	cm^2	3			
		Product amount- Regular powder	6.9	mg	2			
		Product amount- Compact Powder	3.5	mg	2			
		Product amount- Regular liquid	6.9	mg	2			
		Product amount- Compact liquid	4.2	mg	2			

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017			Cleaning Products Fact Sheet 2006		
			Default Value	Unit	Q-factor	Default Value	Unit	Q-Factor
		Product amount-Tablet	3.5	mg	2			
		Product amount-Capsule	4.2	mg	2			
Wearing machine washed clothes (6.1.4-3.1.3)	General	Frequency	365	per year	4	365	per year	3
	Dermal- direct product contact - migration	Product amount	1	kg	3	1	kg	3
		Exposed area	1.7	m^2	4	Not included in FS 2006		
		Leachable fraction - Regular Powder	0.000076	X Wf	1	0.003	X Wf	1
		Leachable fraction - Compact Powder	0.000038	X Wf	1	Not included in FS 2006		
		Leachable fraction - Regular Liquid	0.000076	X Wf	1			
		Leachable fraction - Compact Liquid	0.000045	X Wf	1			
		Leachable fraction - Tablet	0.000076	X Wf	1			
		Leachable fraction - Capsule	0.000045	X Wf	1			
		Skin-contact factor	0.8	(-)	2	0.8	(-)	2
Loading hand wash powder (6.2.1)	General	Frequency	52	per year	4	Not included in FS 2006		
	Inhalation- exposure to spray - instantaneous release	Exposure duration	0.25	min	3			
		Product amount	6.2	µg	1			
		Room volume	1	m^3	1			
		Ventilation rate	2	per hour	3			
	Dermal- direct product contact - constant rate	Contact rate	5	mg/ min	3			
		Release duration	0.25	min	3			
		Exposed area	225	cm^2	4			
Loading hand wash liquids (6.2.2)	General	Frequency	52	per year	4	Not Included In FS 2006		
	Inhalation- exposure to vapour evaporation	Exposure duration	0.75	min	3			
		Product amount	500	g	3			
		Room volume	1	m^3	1			
		Ventilation rate	2	per hour	1			
		Release area	20	cm^2	2			
		Application duration	0.3	min	3			
		Temperature	20	°C	4			

Scenario (Section FS 2017-Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix	90	g/mol	2			
	Dermal- direct product contact- instant application loading	Exposed area	225	cm²	3			
		Product amount	0.01	g	3			
Hand washing of clothes (6.2.3-3.1.2)	General	Frequency	52	per year	4	104	per year	3
	Inhalation-exposure to vapour evaporation	Exposure duration	10	min	3	Not Included In FS 2006		
		Product amount - Regular powder	132	g	3			
		Product amount - Regular liquid	66	g	3			
		Product amount - Compact powder	132	g	3			
		Product amount - Compact liquid	90	g	3			
		Dilution factor - Regular powder	0.0088	(-)				
		Dilution factor - Regular liquid	0.0044					
		Dilution factor - Compact powder	0.0088					
		Dilution factor - Compact liquid	0.006					
		Room volume	10	m³	3			
		Ventilation rate	2	per hour	4			
		Release area	1500	cm²	3			
		Application duration	10	min	3			
		Temperature	40	0 C	3			
		Mass transfer coefficient	10	m/h	3			
		Molecular weight matrix	18	g/mol	4			
	Dermal- direct product contact- instant application loading	Exposed area	2200	cm²	3	1900	cm²	3
		Product amount - Regular powder	0.176	g	3	Not included in FS 2006		
		Product amount- Regular liquid	0.088	g	3	0.19	g	X
		Product amount - Compact powder	0.176	g	3	Not included in FS 2006		
		Product amount - Compact liquid	0.106	g	3			

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
		Product amount pastes	Not included in FS 2017			0.19	g	X
Spot treatment with granule or liquid spot removers (6.3.1- 3.4.3)	General	Frequency	128	per year	2	128	per year	3
	Dermal- direct product contact - instant application	Exposed area	450	cm^2	3	430	cm^2	3
		Product amount	0.325	g	1	0.065	g	1
Spot treatment with spray spot remover (6.3.2- 3.4.2)	General	Frequency	128	per year	3	128	per year	3
	Inhalation- exposure to spray- spraying release	Spray duration	0.04	min	3	0.05	min	3
		Exposure duration	10	min	3	10	min	3
		Room volume	10	m^3	3	10	m^3	3
		Room height	2.5	m	3	2.5	m	4
		Ventilation rate	2	per hour	3	2	per hour	3
		Mass generation rate	1.6	g/s	3	1.5	g/s	3
		Airborne fraction	0.2	(-)	3	0.2	(-)	2
		Weight fraction non-volatile	Not included in FS 2017			0.1	g/g	2
		Density non-volatile	1.8	g/cm^3	3	1.8	g/cm^3	3
		Initial particle distribution (c.v.)	100	μm	3	100	μm	3
		Initial particle distribution (median)	0.37	μm	3	0.6	μm	3
		Inhalation cut-off diameter	15	μm	3	15	μm	3
	Dermal- direct product contact - instant application loading	Exposed area	450	cm^2	3	430	cm^2	3
		Product amount	1	g	1	0.2	g	1
	Dermal- direct product contact- constant rate loading	Contact rate	Not included in FS 2017			46	mg/min	3
		Release duration				0.05	min	3
Wearing spot treated clothes (6.3.3)	General	Frequency	128	per year	3	Not Included In FS 2006		
	General	Frequency	52	per year	4			
	Dermal- direct product contact - migration	Exposed area	1.7	m^2	3			
		Product amount	1	kg	3			
		Leachable fraction -machine wash-liquid spot	1.5E-06	X Wf	2			

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
		remover						
		Leachable fraction --machine wash-spray spot remover	6.6E-06	X Wf	2			
		Leachable fraction -hand wash-liquid spot remover	5E-07	X Wf	2			
		Leachable fraction -hand wash- spray spot remover	2.2E-06	X Wf	2			
Loading of dishwash machine powder (7.1.1- 4.2.2)	General	Frequency	365	per year	3	252	per year	3
	Inhalation-exposure to spray-instantaneous release	Exposure duration	0.25	min	3	0.25	min	3
		Product amount	2.5	μg	1	0.27	μg	1
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	2.5	per hour	3	2.5	per hour	3
	Dermal-direct product contact-constant rate loading	Constant rate	5	mg/min	3	Not Included In FS 2006		
		Release duration	0.25	min	3			
		Exposed area	225	cm^2	4			
Loading of dishwash machine liquid detergents (7.1.2)	General	Frequency	365	per year	3	426	per year	3
	Inhalation-Evaporation-constant rate	Exposure duration	0.75	min	3	0.75	g	3
		Product amount	500	g	3	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	2.5	per hour	3	2.5	per hour	3
		Release area	20	cm^2	2	20	cm^2	2
		Application duration	0.3	min	3	0.3	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	60	g/mol	2	36	g/mol	2
	Dermal-direct product contact-instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.01	g	3	0.01	g	3
Loading dish of liquid rinse aids (7.2.1- 4.2.3)	General	Frequency	35	per year	3	35	per year	3
	Inhalation-Evaporation constant rate	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	3	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	2.5	per	1	2.5	per	1

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
				hour			hour	
		Release area	20	cm^2	2	20	cm^2	2
		Application duration	0.3	min	3	0.3	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	36	g/m ol	2	60	g/mol	2
	Dermal- direct product contact- instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.01	g	3	0.01	g	3
Residues on machine washed dinnerware (7.2.2)	General	Frequency	35	per year	3	Not Included In FS 2006		
	Oral-direct oral contact- direct oral intake loading	Amount ingested	2.25	mg	1			
Loading of liquid dishwasher (7.3.1-4.1.2)	General	Frequency	426	per year	4	426	per year	3
	Inhalation- exposure to vapour- evaporation	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	3	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	2.5	per hour	1	2.5	per hour	1
		Release area	20	cm^2	2	20	cm^2	2
		Application duration	0.3	min	3	0.3	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	36	g/m ol	2	36	g/mol	2
	Dermal- direct product contact- instant application loading model	Exposed area	2.25	cm^2	3	215	cm^2	3
		Product amount	0.01	g	3	0.01	g	3
Manual dishwashing (7.3.2-4.1.3)	General	Frequency	426	per year	4	426	per year	3
	Inhalation- exposure to vapour evaporation-	Exposure duration	45	min	2	60	min	3
		Product amount	7	g	3	21	g	3
		Dilution Factor	0.00 14	(-)	2	15	l	3
		Room volume	15	m^3	4	15	m^3	4
		Ventilation rate	2.5	per	4	2.5	per	3

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017			Cleaning Products Fact Sheet 2006		
			Default Value	Unit	Q-factor	Default Value	Unit	Q-Factor
				hour			hour	
		Release area	1500	cm²	3	1500	cm²	3
		Application duration	16	min	4	16	min	3
		Temperature	45	°C	3	45	°C	3
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	18	g/mol	4	18	g/mol	4
	Dermal-Exposure instant application - model	Exposed area	2200	cm²	3	860	cm²	3
		Product amount	31	mg	3	12	mg	1
Residues on manual washed dinnerware (7.3.3-4.1.4)	General	Frequency	365	per year	4	365	per year	4
	Oral- direct oral contact- direct oral intake model	Amount ingested	0.42	mg	2	0.42	mg	2
Loading liquid all-purpose cleaners (8.1.1-5.2)	General	Frequency	197	per year	4	104	per year	3
	Inhalation-Evaporation-constant rate	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	3	500	g	3
		Room volume	1	m³	1	1	m³	1
		Ventilation rate	0.5	per hour	3	0.5	per hour	1
		Release area	20	cm²	2	20	cm²	2
		Application duration	0.25	min	3	0.3	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	22	g/mol	2	22	g/mol	2
	Dermal-direct product contact- instant application loading	Exposed area	225	cm²	3	215	cm²	3
		Product amount	0.01	g	3	0.01	g	3
Cleaning with liquid all-purpose cleaner (8.1.2-5.2)	General	Frequency	197	per year	4	104	per year	3
	Inhalation-exposure to vapour evaporation-increasing release	Exposure duration	240	min	1	240	min	3
		Product amount	17	g	2	5	g	2
		Dilution factor	0.013	(-)	2	0.0125	(-)	2
		Room volume	58	m³	4	58	m³	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3

Scenario (Section FS 2017-Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017			Cleaning Products Fact Sheet 2006		
			Default Value	Unit	Q-factor	Default Value	Unit	Q-Factor
		Release area	32	m^2	2	10	m^2	2
		Application duration	20	min	3	20	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	18	g/m ol	4	18	g/mol	4
	Dermal- direct product contact- instant application loading	Exposed area	220 0	cm^2	3	1900	cm^2	3
		Product amount	286	mg	2	237. 5	mg	1
Rubbing-off all-purpose cleaners from cleaned surfaces (8.1.3)	General	Frequency	197	per year	4	Not Included In FS 2006		
	General	Body weight	9	kg	4			
	Dermal – direct product contact – rubbing off loading	Contacted surface	22	m^2	4			
		Dislodgeable amount	12	g	2			
		Transfer coefficient	0.2	m^2/h r	3			
		Contact time	60	min	1			
		Exposed Area	0.3	m^2	4			
	Oral-direct product contact -direct oral intake	Ingested amount	10	% of the total exter nal dose	1			
Spraying with all-purpose cleaners (8.2.1-5.3)	General	Frequency	365	per year	4	365	per year	2
	Inhalation-exposure to spray-spraying release model	Spray duration	0.23	min	3	0.41	min	3
		Exposure duration	60	min	1	60	min	3
		Room volume	15	m^3	4	15	m^3	4
		Room height	2.5	m	3	2.5	m	4
		Ventilation rate	2.5	per hour	3	2.5	per hour	3
		Mass generation rate	1.6	g/s	4	0.78	g/s	3
		Airborne fraction	0.1	(-)	3	0.2	(-)	2
		Density non-volatile	1	g/c m^3	3	1.8	g/c m^3	2
		Initial particle distribution (median)	2.4	μm	3	100	μm	3
		Initial particle distribution (c.v)	0.37	μm	3	0.6	μm	3
		Inhalation cut-off diameter	15	μm	3	15	μm	0

Scenario (Section FS 2017-Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
	Dermal- direct product contact - constant rate loading model	Contact rate	46	mg/min	3	46	mg/min	3
		Release duration	14	s	3	25	s	3
Removal of all-purpose cleaner sprays from treated surfaces (8.2.2-5.3)	General	Frequency	365	per year	4	365	per year	2
	Inhalation-exposure to vapour - evaporation from constant surface (Not included in FS 2017)	Exposure duration	Exposure Scenario Not Included In FS 2017			60	min	3
		Product amount				16.2	g	2
		Room volume				15	m³	4
		Ventilation rate				2.5	per hour	3
		Release area				1.71	m²	3
		Application duration				10	min	3
		Temperature				20	°C	4
		Mass transfer coefficient				Langmuir	m/h	X
		Molecular weight matrix				22	g/mol	2
	Dermal- direct product contact- instant application loading	Exposed area	225	cm²	3	215	cm²	3
		Product amount	0.31	g	2	0.16	g	1
Cleaning surfaces with all-purpose cleaner tissues (8.3.1-5.4)	General	Frequency	88	per year	4	365	per year	2
	Inhalation-exposure to vapour-evaporation-increasing release-model	Exposure duration	240	min	1	60	min	3
		Product amount	11.2	g	4	3.42	g	3
		Room volume	20	m³	4	20	m³	3
		Ventilation rate	0.6	per hour	3	0.6	per hour	3
		Release area	2	m²	2	2	m²	2
		Application duration	5	min	3	2	min	2
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	22	g/mol	2	22	g/mol	2
	Dermal- direct product contact instant application loading	Exposed area	225	cm²	3	215	cm²	3
		Product amount	0.05	g	3	0.047	g	3
Scattering abrasive powder	General	Frequency	91	per year	4	104	per year	3
	Inhalation-	Spray duration	1	min	2	1	min	2

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
(9.1.1- 6.2)	exposure to spray-spraying release	Exposure duration	60	min	3	60	min	3
		Room volume	15	m^3	4	15	m^3	4
		Room height	2.5	m	4	2.5	m	4
		Ventilation rate	2.5	per hour	3	2.5	per hour	3
		Mass generation rate	0.58	g/s	4	0.62	g/s	2
		Airborne fraction	0.2	(-)	1	0.2	(-)	1
		Density non-volatile	3	g/c m^3	4	3	g/c m^3	3
		Initial particle distribution (median)	75	µm	1	75	µm	1
		Initial particle distribution (c.v)	0.6	µm	1	0.6	µm	1
		Inhalation cut-off diameter	15	µm	3	15	µm	0
	Dermal- direct product contact-constant rate loading	Contact rate	5	mg/ min	1	5	mg/min	1
		Release duration	1	min	2	1	min	2
Polishing surfaces with abrasive powder (9.1.2)	General	Frequency	91	per year	4	Not Included In FS 2006		
	Dermal-direct product contact-instant application loading	Exposed area	225	cm^2	3			
		Product amount	1	g	2			
Polishing surfaces with abrasive liquids (9.2.1-6.1)	General	Frequency	135	per year	4	156	per year	3
	Inhalation-exposure to vapour-evaporation-increasing release	Exposure duration	60	min	3	10	min	2
		Product amount	32	g	4	37	g	3
		Room volume	15	m^3	4	2.5	m^3	3
		Ventilation rate	2.5	per hour	3	2	per hour	3
		Release area	2	m^2	3	4	m^2	2
		Application duration	20	min	3	7.6	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	45	g/m ol	2	45	g/mol	2
	Dermal- direct product contact-instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.9	g	2	0.37	g	1

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
Loading liquid bathroom cleaners (10.1.1.1-7.1.2)	General	Frequency	156	per year	4	4	per year	2
	Inhalation-exposure to vapour evaporation	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	3	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	2	per hour	3	2	per hour	1
		Release area	20	cm^2	2	20	cm^2	2
		Application duration	0.3	min	3	0.3	min	3
		Temperature	20	°C	3	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	36	g/m ol	2	26	g/mol	2
	Dermal-direct product contact-instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.01	g	3	0.01	g	3
Cleaning with liquid bathroom cleaners (10.1.2-7.1.2)	General	Frequency	156	per year	4	4	per year	2
	Inhalation - exposure to vapour-evaporation increasing release	Exposure duration	25	min	3	25	min	2
		Product amount	4.3	g	2	5.8	g	2
		Dilution factor	0.01 34	ml	2	0.02 2	(-)	2
		Room volume	10	m^3	4	10	m^3	3
		Ventilation rate	2	per hour	3	2	per hour	3
		Release area	8	m^2	3	6.4	m^2	3
		Application duration	20	min	4	20	min	2
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	18	g/m ol	4	18	g/mol	4
	Dermal-direct product contact-instant application loading	Exposed area	220 0	cm^2	3	1900	cm^2	3
		Product amount	295	mg	3	422	mg	3
Spraying with bathroom cleaner (10.1.2.1-7.1.1)	General	Frequency	120	per year	4	52	per year	3
	Inhalation-exposure to spray-spraying	Spray duration	1.2	min	3	1.5	min	3
		Exposure duration	24	min	3	25	min	2
		Room volume	10	m^3	4	10	m^3	3

Scenario (Section FS 2017-Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
	release	Room height	2.5	m	4	2.5	m	4
		Ventilation rate	2	per hour	3	2	per hour	3
		Mass generation rate	1.25	g/s	3	0.39	g/s	3
		Airborne fraction	0.2	(-)	2	0.2	(-)	2
		Density non-volatile	1.8	g/c m^3	3	1.8	g/c m^3	2
		Initial particle distribution (median)	3.6	µm	3	100	µm	3
		Initial particle distribution (c.v.)	0.52	µm	3	0.6	µm	3
		Inhalation cut-off diameter	15	µm	3	15	µm	3
	Dermal- direct product contact - constant rate loading model	Contact rate	46	mg/ min	3	46	mg/min	3
		Release duration	1.2	min	3	1.5	min	3
Cleaning with bathroom cleaner spray (10.1.2.2-7.1.1)	General	Frequency	120	per year	4	52	per year	3
	Inhalation-evaporation from constant surface (Not included in FS 2017	Exposure duration	Not Included In FS 2017			25	min	2
		Product amount				30	g	2
		Room volume				10	m^3	3
		Ventilation rate				2	per hour	3
		Release area				6.4	m^2	3
		Application duration				20	min	2
		Temperature				20	°C	4
		Mass transfer coefficient				Lang muir	m/h	X
		Molecular weight matrix				36	g/mol	2
	Dermal-direct product contact-instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.62	g	3	0.3	g	1
Cleaning a toilet pan (10.2-7.2)	General	Frequency	156	per year	4	Not included in FS 2006		
		Frequency -Acid toilet cleaner	Not included in FS 2017			260	per year	3
		Frequency -Bleach toilet cleaner				120	per year	3
	Inhalation-exposure to vapour evaporation	Exposure duration	7	min	3	3	min	3
		Product amount - Acid toilet pan cleaner	55	g	3	56	g	2

Scenario (Section FS 2017-Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
		Product amount - Bleach toilet pan cleaner	80	g	3	83	g	2
		Room volume	2.5	m^3	2	2.5	m^3	3
		Ventilation rate	2	per hour	3	2	per hour	3
		Release area	0.175	m^2	2	0.075	m^2	3
		Application duration	2	min	4	2	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
	Dermal- direct product contact - constant rate loading	Exposed area	2200	cm^2	3	215	cm^2	3
		Contact rate	193	mg/min	2			
		Release duration	2	min	4	Not included in FS 2006		
Inhalation from toilet rim blocks (10.3-7.3)	General	Frequency	365	per year	4	365	per year	3
	Inhalation-exposure to vapour-instantantenous release*2	Exposure duration	50	min	1	1440	min	1
		Product amount-Solid rim blocks	0.21	g	2	0.21	g	2
		Product amount-Liquid rim blocks	0.24	g	2	0.24	g	2
		Room volume	2.5	m^3	4	2.5	m^3	4
		Ventilation rate*2	0	per hour	2	0	per hour	2
Loading floor cleaning liquids (11.1.1.1-8.1.1)	General	Frequency	161	per year	4	104	per year	3
	Inhalation-exposure to vapour-evaporation-constant release model	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	3	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	0.5	per hour	1	0.5	per hour	1
		Release area	20	cm^2	2	20	cm^2	2
		Application duration	0.3	min	3	0.3	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	36	g/mol	2	22	g/mol	2
	Dermal-direct product contact-instant application loading model	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.01	g	3	0.01	g	3
Cleaning	General	Frequency	161	per	4	104	per	3

Scenario (Section FS 2017-Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
the floor with liquid (11.1.1.2-8.1.1)				year			year	
	Inhalation-exposure to vapour-evaporation-increasing release	Exposure duration	240	min	3	240	min	3
		Product amount	15	g	2	44	g	2
		Dilution factor	0.0164	(-)	2	0.05	(-)	3
		Room volume	58	m^3	4	58	m^3	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m^2	4	22	m^2	4
		Application duration	20	min	4	30	min	2
		Temperature	20	°C	2	20	°C	2
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	18	g/mol	4	18	g/mol	4
	Dermal- direct product contact-instant application loading	Exposed area	2200	cm^2	3	1900	cm^2	3
		Product amount	0.36	g	2	0.95	g	1
Rubbing off floor cleaning liquid from cleaned surfaces (11.1.1.3)	General	Frequency	161	per year	4	Not Included In FS 2006		
		Body weight	9	kg	4			
	Dermal – direct product contact – rubbing off loading model	Contacted surface	22	m^2	3			
		Dislodgeable amount	0.2	g	2			
		Transfer coefficient	0.2	m^2/hr	3			
		Contact time	60	min	2			
		Exposed Area	0.3	m^2	4			
	Oral-direct product contact -direct oral intake model	Frequency	10	% of the total external dose	1			
Mixing and loading floor strip products (11.1.2.1)	General	Frequency	1	per year	1	Not Included In FS 2006		
	Inhalation-exposure to vapour-evaporation-constant release model	Exposure duration	0.75	min	3			
		Product amount	500	g	3			
		Room volume	1	m^3	1			
		Ventilation rate	0.5	per hour	1			
		Release area	20	cm^2	2			
		Application duration	0.25	min	3			
		Temperature	20	°C	4			

Scenario (Section FS 2017-Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix	30	g/mol	2			
	Dermal-direct product contact-instant application loading model	Exposed area	225	cm²	3			
		Product amount	0.01	g	3			
Treating the floor with strip products (11.1.2.2.-8.1.3)	General	Frequency	1	per year	1	1	per year	1
	Inhalation-exposure to vapour evaporation increasing release	Exposure duration	90	min	1	90	min	3
		Product amount	18	g	2	550	g	3
		Room volume	58	m³	4	58	m³	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m²	2	22	m²	4
		Application duration	90	min	3	90	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	18	g/mol	4	22	g/mol	4
	Dermal- direct product contact-instant application loading	Exposed area	2200	cm²	3	430	cm²	3
		Product amount	0.44	g	2	5.5	g	1
Treating the floor with seal products (11.1.2.3-8.1.3)	General	Frequency	1	per year	1	0.1	per year	1
	Inhalation-exposure to vapour evaporation increasing release	Exposure duration	90	min	3	90	min	3
		Product amount-Polyacrylate based sealer	2.7	kg	2	1.5	kg	3
		Product amount-Water based sealer	2.2	kg	2	1.5	kg	3
		Room volume	58	m³	4	58	m³	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m²	2	22	m²	4
		Application duration	90	min	2	90	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix -	90	g/mol	2	22	g/mol	4

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
		Polyacrylate based sealer						
		Molecular weight matrix - Water based sealer	22	g/mol	2	22	g/mol	4
	Dermal- direct product contact- instant application loading	Exposed area	225	cm²	3	430	cm²	3
		Product amount- Polyacrylate based sealer	2.75	g	1	15	g	1
		Product amount- Water based sealer	2.25	g	1	15	g	1
Treating the floor with liquid polish (11.1.3.1- 8.1.3)	General	Frequency	52	per year	4	2	per year	3
	Inhalation- exposure to vapour evaporation increasing release	Exposure duration	90	min	2	90	min	3
		Product amount	550	g	2	550	g	3
		Room volume	58	m³	4	58	m³	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m²	4	22	m²	4
		Application duration	90	min	3	90	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	22	g/mol	2	22	g/mol	4
	Dermal- direct product contact- instant application loading	Exposed area	225	cm²	3	430	cm²	3
		Product amount	0.55	g	2	5.5	g	1
Spraying polish on the floor (11.1.3.2.1)	General	Frequency	52	per year	4	Not Included In FS 2006		
	Inhalation - exposure to spray - spraying release	Spray duration - Trigger sprays	125	s	2			
		Spray duration - Aerosol cans	167	s	2			
		Exposure duration	20	min	1			
		Room volume	20	m³	4			
		Room height	2.5	m	4			
		Ventilation rate	0.6	hour	3			
		Mass generation rate - Trigger spray	1.6	g/s	3			
		Mass generation rate - Aerosol spray can	1.2	g/s	3			
		Airborne fraction	0.2	(-)	3			

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
		Density non-volatile	1.8	g/cm³	3			
		Initial particle distribution (median)	10.8	µm	3			
		Initial particle distribution (c.v.)	0.81	µm	3			
		Inhalation cut-off diameter	15	µm	3			
	Dermal- direct product contact-constant rate loading	Contact rate - Trigger Spray	46	mg/min	3			
		Contact rate - Aerosol spray can	100	mg/min	3			
		Release duration-Trigger spray	125	s	3			
		Release duration-Aerosol spray can	167	s	3			
Polishing the sprayed floor (11.1.3.2.2)	General	Frequency	52	per year	4	Not Included In FS 2006		
	Dermal-direct product contact-instant application loading model	Exposed area	225	cm²	3			
		Product amount	0.55	g	2			
Mounting a wet wipe and cleaning the floor (11.1.4.1)	General	Frequency	66	per year	4	Not Included In FS 2006		
	Inhalation-exposure to vapour-evaporation-increasing release	Exposure duration	240	min	1			
		Product amount	20	g	3			
		Room volume	20	m³	3			
		Ventilation rate	0.6	per hour	3			
		Release area	8	m²	3			
		Application duration	10	min	3			
		Temperature	20	°C	4			
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix	36	g/mol	2			
	Dermal- direct product contact-instant application loading model	Exposed area	225	cm²	3			
		Product amount	0.05	g	3			
Cleaning the floor with a mop system and removing the pad	General	Frequency	161	per year	4	104	per year	3
	Inhalation-exposure to vapour evaporation-	Exposure duration	240	min	3	240	min	3
		Product amount	15	g	2	245	g	3
		Room volume	58	m³	4	58	m³	4

Scenario (Section FS 2017 - Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
(11.1.5.1 - 8.1.2)	increasing release	Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m^2	4	22	m^2	4
		Application duration	20	min	4	30	min	2
		Temperature	20	°C	2	20	°C	2
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	22	g/m ol	4	22	g/mol	4
	Dermal- direct product contact- instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.04	g	3	0.25	g	1
Loading of liquid carpet cleaner (11.2.1.1.1 - 8.2.1)	General	Frequency	52	per year	4	0.5	per year	3
	Inhalation- exposure to vapour- evaporation- constant release	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	3	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	0.5	per hour	3	0.5	per hour	1
		Release area	20	cm^2	2	20	cm^2	2
		Application duration	0.3	min	3	0.3	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	30	g/m ol	2	36	g/mol	2
	Dermal- direct product contact- instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.01	g	3	0.01	g	3
Cleaning the carpet with liquid (11.2.1.1.2 - 8.2.1)	General	Frequency	52	per year	4	0.5	per year	3
	Inhalation- exposure to vapour evaporation- increasing release	Exposure duration - manual cleaning	110	min	1	110	min	3
		Exposure duration - machine cleaning	55	min	1	Not included in FS 2006		
		Product amount	660	g	3	500	g	2
		Dilution factor	0.066	(-)	2	0.05	(-)	3
		Room volume	58	m^3	4	58	m^3	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m^2	4	22	m^2	4

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
		Application duration - Manual cleaning	110	min	1	110	min	3
		Application duration - Machine cleaning	55	min	1			
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	18	g/mol	4	18	g/mol	4
	Dermal- direct product contact- instant application loading	Exposed area	2200	cm^2	3	860	cm^2	3
		Product amount	1.5	g	2	0.01	g	3
Rubbing off carpet cleaner liquid from treated surfaces (11.2.1.2)	General	Frequency	52	per year	4	Not Included In FS 2006		
	General	Body weight	9	kg	4			
	Dermal – direct product contact – rubbing off loading model	Contacted surface	22	m^2	4			
		Dislodgeable amount	9	g/m^2	2			
		Transfer coefficient	0.2	m^2/hr	3			
		Contact time	60	min	1			
		Exposed Area	0.3	m^2	4			
	Oral-direct product contact -direct oral intake	Ingested amount	10	% of the total external dose	1			
Scattering carpet powder (11.1.2.1-8.2.3)	General	Frequency	52	per year	4	0.5	per year	3
	Inhalation-exposure to vapour – evaporation - increasing release area model*3	Exposure duration	11	min	2	22	min	2
		Product amount	2.2	kg	2	2244	g	2
		Room volume	58	m^3	3	58	m^3	3
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m^2	4	Not Included in FS 2006		
		Application duration	30	min	2			
		Temperature	20	°C	4			
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix	45	g/mol	2			
	Dermal-direct product contact -	Contact rate	5	mg/min	1	5	mg/min	2

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
	constant release loading							
Rubbing off carpet cleaning powder from treated surfaces (11.2.2.2-8.2.3)	General	Frequency	52	per year	2	14	per year	3
		Body weight	9	kg	4	8.69	kg	4
	Dermal – direct product contact – rubbing off loading	Contacted surface	22	m^2	4	22	m^2	4
		Dislodgeable amount	3	g/ m^2	1	3	g/ m^2	2
		Transfer coefficient	0.2	m^2/hr	3	0.6	m^2/hr	2
		Contact time	60	min	2	60	min	2
		Exposed Area	0.3	m^2	4			
	Oral-direct product contact -direct oral intake	Ingested amount	10	% of the total external dose	1	10	% of the total external dose	1
Leave-on and rubbing in carpet spot remover (11.2.3.1-8.2.4)	General	Frequency	10	per year	3	10	per year	3
	Inhalation-exposure to vapour – evaporation	Emission duration	5	min	2	Exposure Scenario Not Included In FS 2006		
		Product amount	8	g	2			
		Room volume	58	m^3	4			
		Ventilation rate	0.5	per hour	3			
		Temperature	20	°C	4			
		Exposure duration	15	min	2			
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix	115	g/mol	2			
	Dermal- direct product contact - instant application loading	Exposed area	75	cm^2	3	215	cm^2	3
		Product amount	0.5	g	2	0.07	g	1
Spraying polish on furniture (11.3.1.1)	General	Frequency	1	per year	4	Not Included In FS 2006		
	Inhalation - exposure to spray - spraying release model (Not included in FS 2006)	Spray duration	111	s	2			
		Exposure duration	90	min	1			
		Room volume	20	m^3	3			
		Room height	2.5	m	4			
		Ventilation rate	0.6	per hour	4			
		Mass generation rate	1.8	g/s	3			

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
		Airborne fraction	0.2	(-)	3			
		Density non-volatile	1.8	g/cm³	3			
		Initial particle distribution (median)	10.8	µm	3			
		Initial particle distribution (c.v.)	0.81	µm	3			
		Inhalation cut-off diameter	15	µm	3			
	Dermal- direct product contact- constant rate loading	Contact rate - Trigger sprays	46	mg/min	3			
		Contact rate - Aerosol spray cans	100	mg/min	3			
		Release duration	30	min	1			
Polishing sprayed furniture (11.1.3.2)	General	Frequency	1	per year	4	Not Included In FS 2006		
	Dermal-direct product contact- instant application loading	Exposed area	225	cm²	3			
		Product amount	0.56	g	1			
Treating furniture with liquid polish (11.3.2.1.1 - 8.3.1)	General	Frequency	1	per year	4	1	per year	2
	Inhalation- exposure to vapour- evaporation- increasing release	Exposure duration	90	min	2	240	min	3
		Product amount	550	g	2	550	g	3
		Room volume	58	m³	4	58	m³	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m²	1	22	m²	4
		Application duration	90	min	3	90	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	272	g/mol	1	272	g/mol	1
	Dermal- direct product contact- instant application loading	Exposed area	450	cm²	3	430	cm²	3
		Product amount	1.1	g	2	5.5	g	1
Spraying leather maintenance spray (11.3.1.1- 8.3.2)	General	Frequency	5	per year	2	1	per year	2
	Inhalation- exposure to spray- spraying release	Spray duration- Trigger spray	68	s	3	180	s	2
		Spray duration- Aerosol spray can	90	s	3	180	s	2
		Exposure duration	240	min	4	240	min	3

Scenario (Section FS 2017-Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
		Room volume	58	m^3	4	58	m^3	4
		Room height	2.5	m	3	2.5	m	3
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Mass generation rate -Trigger spray	1.6	g/s	3	0.75	g/s	3
		Mass generation rate - Aerosol spray can	1.2	g/s	3	0.75	g/s	3
		Airborne fraction	0.2	(-)	3	1	(-)	2
		Density non-volatile	1.8	g/c m^3	3	1.8	g/c m^3	3
		Initial particle distribution (median)	10.8	µm	3	25	µm	3
		Initial particle distribution (c.v.)	0.81	µm	2	0.4	µm	3
		Inhalation cut-off diameter	15	µm	3	15	µm	3
	Dermal- direct product contact-constant rate loading	Contact rate	100	mg/min	3	100	mg/min	3
		Release duration	3	min	2	3	min	2
Spraying glass cleaner (12.1.1-9.1)	General	Frequency	66	per year	4	365	per year	2
	Inhalation-exposure to spray-spraying release	Spray duration	21	s	2	42	s	3
		Exposure duration	10	min	3	240	min	3
		Room volume	58	m^3	4	58	m^3	4
		Room height	2.5	m	4	2.5	m	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Mass generation rate	1.6	g/s	3	0.78	g/s	3
		Airborne fraction	0.2	(-)	2	0.2	(-)	2
		Density non-volatile	1.8	g/c m^3	3	1.8	g/c m^3	3
		Initial particle distribution (median)	2.4	µm	3	100	µm	3
		Initial particle distribution (c.v)	0.37	µm	3	0.6	µm	3
		Inhalation cut-off diameter	15	µm	3	15	µm	3
	Dermal- direct product contact constant rate loading	Contact rate	46	mg/min	3	46	mg/min	3
		Release duration	43	s	3	43	s	3
Cleaning surfaces	General	Frequency	66	per year	4	365	per year	2

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
with glass cleaner (12.1.2- 9.1)	Dermal-direct product contact - instant application loading model	Exposed area	75	cm^2	3	215	cm^2	3
		Product amount	0.75	g	2	0.29	g	1
Cleaning surfaces with metal cleaner (12.2.1- 9.3)	Frequency	General	6	per year	2	6	per year	2
	Inhalation- exposure to vapour- evaporation- release area model	Exposure duration	60	min	3	60	min	3
		Product amount - Water based	40	g	2	10	g	2
		Product amount - Naptha based	46	g	2	10	g	2
		Dilution factor - Water based	0.5	(-)	2	Not included in FS 2006		
		Dilution factor - Naptha based	0.57	(-)	2			
		Room volume	15	m^3	4	15	m^3	4
		Ventilation rate	2.5	per hour	3	2.5	per hour	3
		Release area	2	m^2	3	1.71	m^2	3
		Application duration	20	min	2	10	min	2
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix - Water based	20	g/m ol	2	22	g/mol	2
		Molecular weight matrix - Naptha based	35	g/m ol	2	22	g/mol	2
	Dermal- direct product contact constant rate loading model	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount - Water based	1.1	g	2	0.1	g	1
		Product amount - Naptha based	1.3	g	2	0.1	g	1
Pouring drain opener down the drain (12.3.1- 9.4)	General	Frequency	24	per year	2	4	per year	2
	Inhalation- exposure to vapour- evaporation	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	3	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	0.5	per hour	1	0.5	per hour	1
		Release area	20	cm^2	2	20	cm^2	2
		Application duration	0.3	min	3	0.3	min	3
		Temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X

Scenario (Section FS 2017-Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017			Cleaning Products Fact Sheet 2006		
			Default Value	Unit	Q-factor	Default Value	Unit	Q-Factor
		Molecular weight matrix - Sulphuric acid	98	g/mol	2	22	g/mol	2
		Molecular weight matrix - Water based	19	g/mol	2	22	g/mol	2
		Molecular weight matrix - Granules	23	g/mol	2	22	g/mol	3
	Dermal- direct product contact- instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount - Sulphuric acid	1	mg	2	0.01	g	3
		Product amount - Water based	1	mg	2	0.01	g	3
		Product amount - Granules	1.25	mg	2	0.01	g	3
Leaving drain opener to soak (12.3.2-9.4)	General	Frequency	24	per year	2	4	per year	2
	Inhalation- exposure to vapour- evaporation model (Not included in FS 2006)	Exposure duration - Sulphuric acid	30	min	2	Not Included In Fact Sheet 2006		
		Exposure duration - Water based	30	min	2			
		Exposure duration - Granules	15	min	2			
		Product amount - Sulphuric acid	550	g	2	500	g	2
		Product amount - Water based	300	g	2	500	g	2
		Product amount - Granules	70	g	2	500	g	2
		Room volume	20	m^3	3	Not Included In Fact Sheet 2006		
		Ventilation rate	0.6	per hour	3			
		Release area	20	cm^2	1			
		Application duration - Sulphuric acid	30	min	2			
		Application duration - Water based	30	min	2			
		Application duration - Granules	15	min	2			
		Temperature - Sulphuric acid	20	°C	4			
		Temperature - Water based	20	°C	4			
		Temperature - Granules	95	°C	2			
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix - Sulphuric acid	98	g/mol	2			

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
		Molecular weight matrix - Water based	19	g/mol	2			
		Molecular weight matrix - Granules	21	g/mol	2			
Spraying shoe polish (12.4.1.1- 9.5.1)	General	Frequency	12	per year	4	8	per year	3
	Inhalation: exposure to spray-spraying release	Spray duration	46	s	2	72	s	3
		Exposure duration	5	min	2	5	min	3
		Room volume	34	m^3	3	34	m^3	3
		Room height	2.5	m	4	2.5	m	4
		Ventilation rate	1.5	per hour	3	1.5	per hour	3
		Mass generation rate	1.8	g/s	2	0.5	g/s	3
		Airborne fraction	0.3	(-)	2	1	(-)	2
		Initial particle distribution (median)	10.8	µm	3	25	µm	3
		Initial particle distribution (c.v.)	0.81	µm	3	0.4	µm	3
		Inhalation cut-off diameter	15	µm	3	15	µm	3
	Dermal: direct product contact - instant application loading*4	Exposed area	450	cm^2	3			
		Product amount	2.7	g	1	0.12	g	3
Polishing shoes with cream (12.4.2.1- 9.5.2)	General	Frequency	12	per year	4	26	per year	3
	Dermal- direct product contact- instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	1.3	g	1	0.1	g	1
Spraying oven cleaner (12.5.1.- 9.2)	General	Frequency	5	per year	4	26	per year	3
	Inhalation- exposure to spray - spraying release	Spray duration - Trigger spray	7.5	s	1	30	s	3
		Spray duration - Aerosol spray can	10	s	1			
		Exposure duration	15	s	1	60	s	3
		Room volume	1	m^3	1	15	m^3	4
		Room height	0.2	m	1	2.5	m	4
		Ventilation rate	2.5	per hour	3	2.5	per hour	3
		Mass generation rate - Trigger spray	1.6	g/s	3	0.78	g/s	3

Scenario (Section FS 2017- Section FS 2006)	Selected Exposure Model	Parameter	Cleaning Products Fact Sheet 2017 Default Value	Unit	Q-factor	Cleaning Products Fact Sheet 2006 Default Value	Unit	Q-Factor
		Mass generation rate - Aerosol spray can	1.2	g/s	3	n.a.	n.a.	n. a.
		Airborne fraction	0.2	(-)	2	0.2	(-)	2
		Initial particle distribution (median)	100	µm	1	100	µm	3
		Initial particle distribution (c.v.)	0.6	µm	1	0.6	µm	3
		Inhalation cut-off diameter	15	µm	3	15	µm	0
	Dermal- direct product contact- instant application loading*5	Exposed area	450	cm^2	3			
		Product amount	0.7	g	2	0.02 3	g	3
Cleaning the oven (12.5.2- 9.2)	General	Frequency	5	per year	4	26	per year	3
	Dermal- direct product contact - instant application loading	Exposed area	225	cm^2	3	430	cm^2	3
		Product amount	0.9	g	1	0.2	g	1

*1 In FS 2006: Inhalation - exposure to vapour - instantaneous release
*2 In FS 2006: Inhalation - exposure to vapour - constant rate
*3 In FS 2006: Inhalation - exposure to spray - spraying
*4 In FS 2006: Dermal - direct product contact - constant rate loading
*5 In FS 2006: Dermal - direct product contact - constant rate loading

Annex II EPHECT survey analysis

Annex II 1.1 EPHECT Data Simulation

The EPHECT ("Emissions, Exposure Patterns and Health Effects of Consumer Products in the EU") project is a European collaborative action co-funded by European Union (Executive Agency for Health and Consumers- EAHC; 2010-2013). The survey performed in the EPHECT project was designed to gain insight in the indoor use and use patterns of consumer products in the EU member states (EPHECT, 2012). A total of 4335 respondents answered a questionnaire across 10 countries to reflect different use and use patterns of 16 cleaning products in Northern Europe (Sweden n=471, Denmark n=449), Western Europe (Germany n=358, France n=487, UK n=351), Southern Europe (Italy n=361, Spain n=578), and Eastern Europe (Poland n=350, Hungary n=565, Czech Republic n=365). Eight of the 16 products considered represent cleaning products of this Fact Sheet, namely all-purpose cleaners, kitchen cleaners, floor cleaners, glass and window cleaners, bathroom cleaners, furniture and floor polish products, and coating products for leather and textiles. For these products, the use frequency (e.g. daily, per week, per month per year) and the amount of product used per event were questioned in the EPHECT survey. Summary data for use frequency and product amount is reported by Johnson and Lucica (EPHECT, 2012). For the purpose of this fact sheet however, the raw data of the survey was kindly provided by EPHECT and analyzed with a Monte Carlo (MC) simulation in order to derive probabilistic distributions for use *frequency* and *product amount*. Note that not all raw data of the EPHECT survey is reported in the summary of Johnson & Lucica (EPHECT, 2012).

Annex II 1.2 Data preparation

The first step to prepare the MC simulation is to convert the qualitative survey data on *product amount* into quantitative amounts (*g*). In Table 1 an overview is provided on the units that were used in the survey and the amounts that were linked to these units (by RIVM, last column).

Table A2: Quantitative conversion of qualitative product amount units in EPHECT respondent data per product category and product use format

Product Category	Product use format	Qualitative amount unit EPHECT Survey(1)	Quantified by RIVM as
All-purpose cleaner	Liquid	Number of caps	40 g/cap(2)
	Spray	Number of sprays	1 -2 g per spray(3)
	Cream	Number of table spoons	20 g per spoon(4)
	Powder	Number of table spoons	20 g per spoon(4)
	Wipes	Number of wipes	20 g per wipe(5)
Kitchen Cleaner	Liquid	Number of caps	40 g/cap(2)
	Spray	Number of sprays	1 -2 g per spray(3)
	Cream	Number of table spoons	20 g per spoon(4)
	Powder	Number of table spoons	20 g per spoon(4)
	Wipes	Number of wipes	5-6 g per wipe(5)
Floor Cleaner	Liquid	Number of caps	40 g/cap(2)
	Spray	Number of sprays	1 -2 g per spray(3)
	Wipes / Tissues	Number of wipes	5-6 g/wipe(5)
	Powder	Number of table spoons	20 g per spoon(4)
Glass and Window Cleaner	Liquid	Number of caps	40 g/cap(2)
	Spray	Number of sprays	1 -2 g per spray(3)
	Wipes / Tissues	Number of wipes	5 g/wipe(5)
Bathroom Cleaner	Liquid	Number of caps	40 g/cap(2)
	Spray	Number of sprays	1 -2 g per spray(3)
	Gel	Number of table spoons	20 g per spoon(4)
	Powder	Number of table spoons	20 g per spoon(4)
	Wipes	Number of wipes	5-6 g per wipe(5)
Furniture Polish	Liquid	Number of caps	40 g/cap2
	Spray	Number of sprays	1 -2 g per spray(3)
	Wipes / Tissues	Number of wipes	5 g/wipe4
Leather and Textile Coatings	Liquid	Number of caps	40 g/cap(2)
	Spray	Number of sprays	1 -2 g per spray(3)
	Cream	Number of table spoons	20 g per spoon(4)

1: EPHECT (2012)
2: Measurement with 2 all-purpose cleaner (cups) available on the Dutch market. Assuming product density of 1 g/ml,
3: Delmaar & Bremmer (2009),
4: Wikipedia: 20 ml, assuming a density of 1 g/ml
5: Weerdesteijn et al. (1999)

The second step in preparing the data is to assign probabilistic distributions to the ranges presented in the multiple choice questions of the original EPHECT questionnaire with respect to *product amount* per product format (Table A3) and *use frequency* per product category (Table A4).

Table A3: Assigned probabilistic distributions for ranges in multiple choice answers EPHECT related to product amounts per product format

Product format	EPHECT Multiple choice answers related product amount	Distribution U = Uniform T= Triangular	Assigned Values U: minimum - maximum T:minimum - mode- maximum
Liquid	Less than 0.5 cap	T	0-20-20 g
	0.5 cap to less than 1 cap	U	20 -40 g
	1 cap to less than 1.5 caps	U	40 – 60 g
	1.5 caps to less than 2 caps	U	60 -80 g
	2 caps to less than 2.5 caps	U	80 – 100 g
	2.5 caps to less than 3 caps	U	100 -120 g
	3 caps to less than 3.5 caps	U	120 -140 g
	3.5 caps to less than 4 caps	U	140 -160 g
	4 caps to less than 4.5 caps	U	160 -180 g
	4.5 caps to less than 5 caps	U	180 -200 g
	3 caps or more	T	120 -120-240 g
	5 caps or more	U	200-220 g
Sprays	1 spraying	U	1 - 2 g
	2 sprayings	U	2 - 4 g
	3 sprayings	U	3 - 6 g
	4 sprayings	U	4 - 8 g
	5 sprayings	U	8 - 10 g
	More than 5 sprayings	T	6 - 6 -14 g
Creams, Foams, Gels and Powders	Less than 0.5 table spoon	T	0 - 10-10 g
	0.5 table spoon to less than 1 table spoon	U	10 - 20 g
	1 tablespoon to less than 1.5 table spoons	U	20 - 30 g
	1.5 tablespoons to less than 2 table spoons	U	30 - 40 g
	2 tablespoons to less than 2.5 table spoons	U	40 -50 g
	2.5 tablespoons to less than 3 table spoons	U	50 -60 g
	3 table spoons or more	T	60-60-120 g
Wipes	1 wipe	U	5-6 g
	2 wipes	U	10-12 g
	3 wipes	U	15-18 g
	4 wipes	U	20-24 g
	5 wipes	U	25-30 g
	More than 5 wipes	T	30-30-72 g

Table A4: Assigned probabilistic distributions for ranges in multiple choice answers EPHECT related to use frequency

EPHECT Multiple choice answers related to use frequency	Distribution P = Point U = Uniform	Assigned values P: point estimate U: minimum - maximum
At least once a day	P	365 per year
Several times a week	U	104 - 312 per year
Once a week	P	52 per year
Once per two weeks	P	26 per year
Once per month	P	12 per year
Less than once a month	U	1 -12 per year

The raw data obtained from the EPHECT survey is then reorganized into a database structured per product used per individual respondent (Table A5). The use frequency per specific product format was not specified per respondent in the original questionnaire of EPHECT. It is therefore assumed the respondent uses the products in the category with an equal frequency, so that:

$$use\ frequency\ product\ format = \frac{use\ frequency\ product\ category}{number\ of\ product\ formats\ respondent\ uses\ in\ the\ category}$$

Table A5: Database structure

Product category and format and respective number of respondents	Respondent ID	Quantified probabilistic distribution for *product amount* per respondent	Quantified probabilistic distribution for *use frequency* per respondent
All-purpose cleaner cream … n=235	540 698 … 92706	U: 20 - 730 g U: 10 - 20 g … U: 0 -10 g	P: 104 per year(1) U: 35 -104 per year(1) … P: 52 per year
All-purpose cleaner liquid … n = 1170	540 700 … 92702	U: 80 -100 g U: 20 -40 g … U: 40-60 g	P: 12 per year U: 35 -104 per year(1) … P: 365 per year
All-purpose cleaner spray … n = 686	540 689 … 92699	U: 2-4 g U: 2-4 g … U: 4-8 g	P: 12 per year U: 35-104 per year(1) … 26 per year
Bathroom cleaner liquid … n = 1006	701 707 … 92761	U: 60 -80 g U: 60 - 80 g … U: 20-40 g	P: 52 per year P: 182 per year(1) … P: 52 per year
Bathroom cleaner wipes … n = 72	834 11008 … 92652	U: 10-12 g U: 5-6g … U: 25-30g	U: 52 -153 per year(1) P: 52 per year … P: 26 per year
Etc... n total =11970	…	…	…

P= Point Estimate, U = Uniform distribution
1: Respondent uses more than one specific format of the product. Frequency is corrected for the use of other product formats in the product category

Annex II 1.3 Data simulation

The database is subject to a MC simulation in which for each respondent-product combination a single value is randomly drawn from the corresponding amount distributions for *product amount* and *use frequency*. Based on these single amount and frequency values population wide amount and frequency distributions were estimated for each product separately. To estimate the amount and frequency distributions for the European users, the individual values available are weighted for the number of inhabitants of each country. Weighing is necessary because the number of surveyed individuals per country is not representative for the entire European population: *A total of 4335 interviews were conducted across the 10 countries. Sample sizes varied between countries, with 368 to 578 interviews conducted in each, ensuring **national** representativeness of consumers of the selected product classes by age, gender and region*.

Each country was assigned a weight (*w*) according to:

$$w_i = \frac{N_i / \sum_{i=1} N_i}{n_i / \sum_{i=1} n_i} \qquad (1)$$

where *i* is country, *N* is the total number of inhabitants (www.europa-nu.nl) and *n* is the number of surveyed individuals.

The product amount is assumed to be lognormally distributed for the entire European population. The lognormal amount distributions are characterized by their geometric mean (GM) and geometric standard deviation (GSD.) or coefficient of variation (c.v.). The GM and GSD are the back-transformed mean and st. dev. of the log transformed raw (individual) data. The c.v. is derived using the following equation:

$$CV = \sqrt{e^{s^2} - 1} \qquad (2)$$

where s^2 is the variance of the log transformed amounts. The mean and variance on log scale are weighted for the number of inhabitants of each country using equations (3) and (4).

$$\bar{x} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i} \qquad (3)$$

$$s^2 = \frac{1}{W_n - 1} \sum_{i=1}^{n} w_i (x_i - \bar{x})^2 \qquad (4)$$

where W_n is the sum of weights.

The frequency is described using a beta distribution, which is characterized by two parameters α and β. The values for these two parameters are derived according to:

$$\alpha = \bar{x} \left(\frac{\bar{x}(1-\bar{x})}{s^2} - 1 \right) \qquad (5)$$

$$\beta = (1 - \bar{x}) \left(\frac{\bar{x}(1-\bar{x})}{s^2} - 1 \right) \qquad (6)$$

Where $\bar{x}$ and s^2 are derived from the reported frequencies without transformation according to equations (3) and (4).

Annex II 1.4 Simulation results

The MC simulation results are probabilistic distribution of *product amounts* and *use frequencies* for the entire European population from which 75th percentile are extracted (Table A6).

Table A6: Probabilistically simulated 5th, 25th, 50th, 75th and 95th percentiles for product amount and use frequency for the entire European population derived from EPHECT survey data.

		Percentiles Product amount (g)					Percentiles Frequency (per year)				
Product Name	n	5th	25th	50th	75th	95th	5th	25th	50th	75th	95th
AllPurposeCleaner_Cream	233	7.2	14.4	22.8	36.4	72.0	1	13	40	84	175
AllPurposeCleaner_Foam	63	6.8	13.6	21.6	34.4	68.0	1	7	22	51	120
AllPurposeCleaner_Gel	225	5.6	12.0	19.6	32.4	68.0	2	12	31	62	128
AllPurposeCleaner_Liquid	1153	9.4	21.0	37.0	65.0	150.0	1	18	80	197	325
AllPurposeCleaner_Powder	142	3.0	7.6	15.2	29.6	76.0	1	9	28	62	131
AllPurposeCleaner_Spray	679	1.5	2.5	3.6	5.1	8.6	1	17	66	153	285
AllPurposeCleaner_Tablets	48	3.8	6.0	8.2	11.0	18.0	1	9	23	47	99
AllPurposeCleaner_Wipes	229	4.2	7.4	11.0	16.0	29.0	1	11	37	88	186
BathroomCleaner_Cream	177	6.8	13.2	21.2	34.0	68.0	1	10	36	88	190
BathroomCleaner_Foam	59	6.4	15.2	27.2	48.0	116.0	2	17	51	110	212
BathroomCleaner_Gel	307	6.8	13.6	22.4	36.8	76.0	1	14	44	99	204
BathroomCleaner_Liquid	989	8.0	19.0	36.0	67.0	160.0	0	12	55	139	277
BathroomCleaner_Powder	97	6.0	12.0	19.2	30.8	60.0	4	20	47	88	164
BathroomCleaner_Spray	740	1.7	3.0	4.4	6.5	12.0	1	14	51	120	241
BathroomCleaner_Tablets	43	3.3	4.6	5.8	7.3	10.0	4	18	40	69	131
BathroomCleaner_Wipes	69	5.0	8.4	12.0	17.0	29.0	2	13	31	62	120
FloorCleaner_Cream	77	11.2	20.8	32.0	48.0	92.0	2	11	27	55	110
FloorCleaner_Foam	48	4.4	12.0	23.2	44.0	120.0	0	3	16	47	124
FloorCleaner_Gel	120	6.4	14.0	24.0	40.0	88.0	0	6	26	73	175

Product Name	n	Percentiles Product amount (g) 5 th	25 th	50 th	75 th	95 th	Percentiles Frequency (per year) 5 th	25 th	50 th	75 th	95 th
FloorCleaner_Liquid	1333	15.0	30.0	50.0	82.0	170.0	0	9	55	161	310
FloorCleaner_Powder	67	10.8	20.4	31.2	48.0	88.0	0	4	20	55	139
FloorCleaner_Spray	212	2	3	4	5	9	1	9	31	73	161
FloorCleaner_Tablets	27	5	8	11	15	24	1	7	16	30	58
FloorCleaner_Wipes	140	5	9	13	19	34	1	11	31	66	135
GlassCleaner_Cream	27	8	16	26	44	84	0	3	18	62	172
GlassCleaner_Foam	33	3	9	18	39	112	0	1	5	23	84
GlassCleaner_Gel	36	4	9	16	29	64	1	7	23	55	124
GlassCleaner_Liquid	617	5	14	30	63	180	0	1	13	66	215
GlassCleaner_Powder	20	13	20	28	38	60	4	13	25	44	80
GlassCleaner_Spray	981	2	3	4	7	12	0	1	13	66	215
GlassCleaner_Tablets	12	6	10	13	18	28	0	2	9	23	58
GlassCleaner_Wipes	95	5	9	13	19	34	0	2	20	73	204
KitchenCleaner_Cream	315	4	10	18	32	76	2	23	66	135	245
KitchenCleaner_Foam	93	5	12	23	44	104	3	21	51	99	186
KitchenCleaner_Gel	183	5	11	19	34	76	2	17	51	113	219
KitchenCleaner_Liquid	952	8	18	33	60	140	2	26	91	193	318
KitchenCleaner_Powder	144	5	12	20	35	80	3	20	47	91	172
KitchenCleaner_Spray	800	2	3	4	6	11	1	24	88	190	314
KitchenCleaner_Tablets	86	4	7	9	12	19	9	28	47	77	128
KitchenCleaner_Wipes	130	5	8	12	18	32	3	19	44	84	157